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National Aeronautics and Space Administration

Table of Contents

Volume 3 Number 11 / June 8, 1965

Abstracts in the journal are grouped under the following categories: PAGE

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. 1753

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 1756

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. 1759

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology. 1765

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences. 1776

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. 1778

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. 1790

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. 1798

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 1802

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **1807**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. . . . **1809**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **1817**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **1823**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **1831**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. **1838**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **1842**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **1844**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1851**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **1853**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **1856**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **1859**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **1860**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 1865

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 1869

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 1877

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 1881

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 1888

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 1889

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 1890

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 1898

31 SPACE VEHICLES
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. 1910

32 STRUCTURAL MECHANICS
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. 1911

33 THERMODYNAMICS AND COMBUSTION
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. 1916

34 GENERAL
Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. 1922

SUBJECT INDEX I-1

CORPORATE SOURCE INDEX I-85

PERSONAL AUTHOR INDEX I-109

REPORT/ACCESSION NUMBER INDEX I-151

ACCESSION/REPORT NUMBER INDEX I-161

VOLUME 3 NUMBER 11

Scientific and Technical Aerospace Reports

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June 8, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-21269# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Engineering

AN EXPERIMENTAL INVESTIGATION OF EIGHT AXISYMMETRIC ANNULAR NOZZLES IN PROXIMITY TO GROUND. PART I: APPARATUS AND METHOD OF TESTING. RESULTS FROM TESTS WITH WIND OFF (HOVERING)

C. Härje G. Thunholm Jun. 1964 94 p refs

(KTH-AERO-TN-54)

This report deals with results from tests with wind-off (hovering). It is evident from the results that lift and volume flow can be estimated comparatively well at zero angle of attack through the combined use of available theories, that the optimum nozzle angle is about 45°, that the resulting force acts perpendicularly to the base surface even at angles of attack up to 9°, and that the model is unstable in pitch over practically the whole investigated domain of parameters. Author

N65-21413# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.

A METHOD FOR COMPUTING TRAJECTORIES OF STORES LAUNCHED FROM AIRCRAFT

James H. Nichols, Jr. Nov. 1964 29 p refs

(DTMB-1878; DTMB-AERO-1079; AD-612515)

Weapons system development should include investigation of adverse interference between aircraft and weapon during design stages, or at least preceding flight. To this end, equations are presented for computing trajectories of store during and following its launch from airplane. These equations, in six degrees of freedom, were developed for use at aerodynamics laboratory for specific purpose of using wind-tunnel test results in conjunction with the point prediction technique. However, equations are adaptable to other methods of trajectory prediction. Author

N65-21483# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

A LIFTING SURFACE METHOD FOR CALCULATING LOAD DISTRIBUTORS AND THE AERODYNAMIC INFLUENCE COEFFICIENT MATRIX FOR WINGS IN SUBSONIC FLOW

John Dulmovits Aug. 1964 51 p refs

(ADR-01-02-64.1)

A subsonic lifting surface method for determining the chordwise and spanwise pressure distributions of any wing at any subsonic Mach number was developed and programed on the IBM 7094 computer. This method is capable of predicting loads due to angle-of-attack, twist, camber, and discontinuities such as flaps and ailerons. The method actually calculates an aerodynamic load matrix which, when postmultiplied by the local slope of the wing mean line at the downwash points, gives the pressure distributions. It was found that meaningful load distributions could be obtained by concentrating enough horseshoe vortices on the wing and satisfying the boundary condition that the downwash at certain points on the wing be equal to the slope of the mean camber line at these points. The lift distribution on the wing in the presence of a fuselage is calculated by a simple system of horseshoe vortices on the wing with images inside the fuselage. Author

N65-21508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ROLLING MOMENT OF FLAT WINGS IN AN OBLIQUE SUPERSONIC GAS FLOW

Yu. I. Krasil'nikov 20 Jun. 1963 18 p refs Transl. into ENGLISH from the book "Inzhenernyy Sbornik" Moscow, Inst. Mekhan. Acad. Nauk SSSR, v. 29, 1960 p 124-135

(FTD-TT-63-402/1+2+4; AD-413599)

The coefficient of the rolling moment is determined for triangular, quadrangular, and pentagonal wings in an oblique supersonic gas flow. The problem is solved in a linearized setup by means of linear theory methods. Author

N65-21563# Ling-Temco-Vought, Inc., Dallas, Tex. LTV-Vought Aeronautics Div.

ANALYSIS OF A LOW SPEED WIND TUNNEL TEST OF A HIGH MASS RATE VECTORED PROPULSION FLOW MODEL

R. T. Stancil and L. J. Mertaugh, Jr. 15 Feb. 1965 95 p refs

(Contract DA-31-124-ARO-D-262)

(Rept.-2-53310/4R-2166; AROD-5260-2; AD-613198)

An analysis of selected portions of the data resulting from a low-speed wind-tunnel test of a semispan model of a VTOL aircraft is presented. The model features an integrated propulsion-lifting surface system as well as a horizontal tail located on an aft, wing-tip extension. The propulsion system flow, simulated with cold air, exhausts over the wing trailing-edge flap (flap jet) and out of the lower surface of the wing (wing box jet). The exhaust flows can be independently vectored through 90°. Force and moment data are presented for both static and forward flight conditions. Some comparisons with theoretical predictions are presented. Portions of the data are shown with the direct thrust components removed. The results of this analysis show that (1) the outboard location of the horizontal tail provides a reduction in airplane induced drag, (2) a significant portion of the theoretical jet flap effect is obtained with the wing box jet directed parallel to the wing

chord plane, (3) a reduced jet flap effect is available with deflections of the wing box jet away from the wing chord plane, and (4) further testing is desirable for a better understanding of the characteristics of this configuration. Author

N65-21720*# Midwest Research Inst., Kansas City, Mo.
STUDY FOR THE INDICIAL LOAD EFFECTS ON MULTI-STAGE SPACE VEHICLE SYSTEMS. VOLUME I: LINEARIZED INDICIAL AERODYNAMIC FORCES ON BODIES OF REVOLUTION IN SUPERSONIC FLOW Annual Summary Report, 21 Jun. 1963–20 Aug. 1964
William D. Glauz 21 Aug. 1964 93 p refs
(Contract NAS8-11012; MRI Proj. 2715-P
(NASA-CR-62199) CFSTI: HC $3.00/MF $0.75

A theory for predicting aerodynamic forces on cone-cylinder bodies encountering a step side gust is developed. The theory satisfies the full linearized potential equation, and satisfies the exact boundary condition when steady-state flow has been achieved. This boundary condition is satisfied in an approximate sense in the transient region of flow. The theory is based on an elementary gust doublet solution. To arrive at the best fundamental solution, the methods of Laplace transforms, superposition of axial and/or surface singularities, and extensions of older theories are studied. A superposition of basic axial singularities is chosen as the best approach. The gust doublet solution yields the solution of Tsien when steady-state conditions occur. For this reason, the Karman–Moore technique is relatively simple to apply when complicated body shapes are to be considered. Author

N65-21736*# National Aeronautics and Space Administration, Washington, D. C.
COLLECTED WORKS OF K. E. TSIOLKOVSKIY. VOLUME I: AERODYNAMICS
B. N. Yur'yev, ed. Apr. 1965 380 p refs Transl. into ENGLISH of the book "K. E. Tsiolkovskiy. Sobraniye Sochineniy. Tom I Aerodinamika" Moscow, Izd. Akad. Nauk SSSR, 1951
(NASA-TT-F-236) CFSTI: HC $7.00/MF $2.00

The works of the Russian scientist, K. E. Tsiolkovskiy, have been collected because of their historical significance to science. This volume includes his papers on aerodynamics. R.N.A.

N65-21826# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique
STUDY OF SUPERSONIC DUCTS OF REVOLUTION FOR LOW DENSITY WIND TUNNELS [ETUDE DE TUYERES SUPERSONIQUES DE REVOLUTION POUR SOUFFLERIES A BASSE DENSITE]
Francoise Desesquelles, Jacqueline Kleman, John Miller, and Philippe Seurin Feb. 1965 58 p refs In FRENCH *Its* Publ. No. 227
(Rept.-65-2)

The making of blow tubes for supersonic rarefied gas wind tunnels poses a particularly difficult problem because of the importance of the boundary layer in focusing the tubes. This boundary layer depends on the Mach number and the pressure in the jet, so it is necessary to calculate for each combination of Mach number and pressure values. Two methods of calculation for the thickness of a laminar boundary layer in circular tubes are reviewed and compared, the method of Owen and Sherman, and the method of Durrand and Potter. Both methods are found to be usable, at least in the case of uncooled tubes. Also described are different methods for calibrating the tubes. M.P.G.

N65-21865# Royal Aircraft Establishment, Farnborough (England).
THE CONSTRUCTION OF A COMPRESSION SURFACE BASED ON AN AXISYMMETRICAL CONICAL FLOW FIELD
B. A. Woods London, Min. of Aviation, Jun. 1963 13 p refs (RAE-TN-AERO-2900)

A method is given for constructing compression surfaces using the flow field behind an axisymmetrical conical shock wave. The construction may be either direct (starting from a prescribed leading edge) or inverse (starting from a prescribed trailing edge), and in the former case employs only direct calculation using available numerical data. Author

N65-21873# Royal Aircraft Establishment, Farnborough (England).
A METHOD FOR DESIGNING LIFTING CONFIGURATIONS FOR HIGH SUPERSONIC SPEEDS USING THE FLOW FIELDS OF NON-LIFTING CONES
J. G. Jones London, Min. of Aviation, Mar. 1963 33 p refs (RAE-AERO-2674)

A method is presented for designing the lower surface of a lifting configuration for high supersonic speeds using the known flow field past a nonlifting circular cone. The leading edge can be prescribed on the conical shock wave, and the lower surface is obtained by replacing the stream surface through this leading edge by a solid surface. Provided that the upper surface is so designed as not to cause shock detachment, the resulting configuration supports a conical shock wave attached at its swept leading edge, with a known flow field between the shock and the lower surface. Author

N65-21886# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CENTRAL AEROHYDRODYNAMICS INSTITUTE, INDUSTRIAL AERODYNAMICS Selected Articles
20 Feb. 1963 42 p refs Transl. into ENGLISH from Osovyye Dozvukovyye Kompressory Statsionarnogo Tipa, Tsentr. Aerogidrodinamicheskiy Inst. (Moscow), no. 20, 1961 p 57–81
(FTD-TT-62-1750/1+2; AD-299631)

CONTENTS:

1. EXPERIMENTAL INVESTIGATION OF TWO ONE-STAGE COMPRESSORS IN A WIDE RANGE OF REYNOLDS NUMBERS S. A. Dovzhik p 1–26 refs (See N65-21887 11-01)

2. CALCULATING TURBINES WITH VARIABLE GAS PARAMETERS ON THE RADIUS N. A. Kolokol'tsev p 27–39 refs (See N65-21888 11-01)

N65-21887 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF TWO ONE-STAGE COMPRESSORS IN A WIDE RANGE OF REYNOLDS NUMBERS
S. A. Dovzhik *In its* Central Aerohydrodyn. Inst., Ind. Aerodyn. 20 Feb. 1963 p 1–26 refs (See N65-21886 11-01)

Reynolds number effect on characteristics of two one-stage compressors differing in geometric parameters and hydrodynamic schemes was tested in a wide range of Reynolds numbers. Both compressors had an outside diameter of 350 mm; one was characterized by an axial flow direction at the inlet to the impeller and at the exit from the alining apparatus, and the aerodynamic scheme of the second compressor was characterized by 100% reaction. The compressors were tested on a variable density installation. Measurements were made on the rotational velocity of the compressor, and the coefficients of axial velocity, power, and adiabatic work and efficiency. The individual components of pressure losses in the vane rims of the compressor varied differently with the Reynolds number: the end and profile losses grew vigorously with drop in Reynolds number while the secondary and slit losses remained nearly constant. It was concluded that individual stages of compressors

with different geometric parameters should change differently with changing Reynolds number, in accord with differences in the structure of the pressure losses. Extension of these results to multistage compressors is considered. J.M.D.

N65-21888 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATING TURBINES WITH VARIABLE GAS PARAMETERS ON THE RADIUS

N. A. Kolokol'tsev *In its* Central Aerohydrodyn. Inst., Ind. Aerodyn. 20 Feb. 1963 p 27–39 refs (See N65-21886 11-01)

A simpler and more general method of calculating a turbine with gas parameters which are variable along the length of the vanes is presented. In this method the equation is written, as usual, for the static parameters and physical velocities of the gas, but use is also made of the parameters of the retarded streams and a quoted gas velocity. Calculated graphs are shown on the effect that change in the entire gas pressure along the radius has on the distribution of the quoted stream velocity along the vane; it appears that change in the pressure of the retarded stream along the radius substantially influences the gas velocity. The case is considered where pressure of the retarded gas is constant along the radius, and only the temperature changes. A graph shows change in degree of reactivity in the stage along the radius at various magnitudes and directions of the velocity behind the nozzle apparatus. Once the gas velocities along the length of the vane are determined, it is possible to calculate the remaining stream and stage parameters. J.M.D.

N65-21899# National Aerospace Lab., Tokyo (Japan). First Airframe Div.

SOME EXPERIMENTS ON CONTROL-SURFACE BUZZ

Yasuharu Nakamura and Yoshikazu Tanabe Nov. 1964 20 p refs

(NAL-TR-72T)

Experimental investigations on the control-surface buzz at transonic speeds were made with a two-dimensional airfoil-flap combination model. Experiment one was devoted to optical observations by using a high speed motion camera with particular emphasis on the growth of buzz, namely from the state of small amplitudes up to the limit cycle of oscillation. In Experiment two, the measurements of the unsteady hinge moment of the flap by a free oscillation method were performed at subsonic and transonic Mach numbers. It was found that the type of buzz occurring at the higher transonic Mach numbers shows "a soft oscillator" characteristics. Also the oscillation, at least at small amplitudes, can be associated with negative damping in potential flow and does not depend on the boundary layer effects. The measured unsteady hinge moments of the flap agreed reasonably with the values predicted by the supersonic unsteady linearized theory. Author

N65-21957# Royal Aircraft Establishment, Farnborough (England).

QUASI-CYLINDRICAL SURFACES WITH PRESCRIBED LOADINGS IN THE LINEARISED THEORY OF SUPERSONIC FLOW

J. G. Jones London, Min. of Aviation, Jun. 1961 24 p refs (RAE-TN-AERO-2769)

A formula for the velocity field in terms of a given surface distribution of vorticity is applied to points lying on the surface. An equation giving the shape of a quasi-circular–cylindrical surface in terms of a prescribed loading is derived. As an example a half-ring wing with prescribed loading is discussed. Author

N65-21958# Royal Aircraft Establishment, Farnborough (England).

FREE-FLIGHT MEASUREMENTS OF THE ZERO-LIFT DRAG OF A SLENDER WING AT MACH NUMBERS BETWEEN 1.4 AND 2.7

C. Kell London, Min. of Aviation, Aug. 1961 14 p refs (RAE-TN-AERO-2779)

The total zero-lift drag of a particular slender-wing design was measured using the free-flight technique, and from these measurements an estimate of the wave drag was made. The results suggest a value of wave drag some 20% higher than that given by supersonic thin-wing theory; the accuracy of this result is shown to be very dependent on the accuracy with which skin friction is estimated. Author

N65-21960# Royal Aircraft Establishment, Farnborough (England).

SOME WIND TUNNEL EXPERIMENTS ON THE REEFING OF PARACHUTES

M. H. L. Waters, D. B. Cobb, and V. J. Bonnett London, Min. of Aviation, Nov. 1960 68 p refs

(RAE-TN-MECH-ENG-329)

The results are presented of an investigation in a 24-ft wind tunnel on various methods of reefing parachutes. Of those tried, rigging point reefing was the best and, for this method, measurements were made at constant speed condition on several parachute designs and for a range of reefing cord lengths. With rigging point reefing it is possible to achieve in the correct design of parachute substantially linear relationship between parachute drag and reefing cord lengths less than approximately 70% of the parachute periphery. The drag of a reefed parachute with 70% reefing is very little less than that of the fully opened parachute. If the parachute has a critical speed close to that at which it is tested, then the reefed parachute will squid and the linear relationship will not be obtained. Author

N65-22056# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

DESIGN, CONSTRUCTION AND TESTING OF AN AGARD STANDARD MODEL D FOR OSCILLATORY DERIVATIVES MEASUREMENTS

H. Starken Nov. 1964 38 p refs

(VKI-TN-21)

Some measurements of pitching moment derivatives of AGARD calibration model D have been performed. A rigidly forced technique with a mass balance system has been used. Tests have been made from 0.003 to 0.18 (0.5 to 12.0 cps). The results for the damping and stiffness term show reasonable agreement with tests made in other low speed wind tunnels. Author

N65-22063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPERATION OF INTAKE DIFFUSORS UNDER VARIABLE CONDITIONS, PART II

Andrzej Kowalewicz 17 Apr. 1963 17 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 6, 1960 p 165–169

(FTD-TT-63-28/1+2; AD-409074)

The unstable operations of diffusers in a supersonic flow and the characteristics of a diffuser as an element of a ramjet engine are discussed. The operational stability of diffusers is influenced by two basic types of vibrations: high frequency low amplitude vibrations which cause no actual disruptions of the engine operations; and buzz vibrations of low frequency

and considerable amplitude which induce periodic changes in engine thrust and may result in extinction of the combustion chamber. Results of investigations on the dimensions and control of these vibrations carried out on diffusers with a conical central body and placed in a supersonic stable airflow are presented. Vibration effects were induced by various degrees of flow through choking. It was found that the buzz frequency lies in the range of 100 to 200 cycles at $Mach_0$ = constant, depending on the ratio of the field of choked-off cross section at the output to the input cross sectional field. Constant control of the diffuser cross section fields is the most effective method to secure proper working conditions. G.G.

N65-22065# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE PROFILE OF LEAST RESISTANCE OF AN ANNULAR WING
B. I. Borisov 11 Jun. 1963 6 p Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 1, 1961 p 62–65
(FTD-TT-63-397/1+2+4; AD-410936)

The profile of least resistance of a thin axisymmetric wing in a supersonic flow at velocity V_0 was determined by expansion of the linearized equation for velocity potential. Calculations are presented for determining dimensionless variables, boundary conditions, drag force, extremum, and symmetrical and rhomboid profiles. S.C.W.

N65-22158# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
TRANSIENT AIRLOADS ON A BODY OF REVOLUTION DUE TO INDICIAL SINKING AT A LARGE ANGLE OF ATTACK
J. Ray Ruetenik and W. Bryan Brooks Aug. 1964 44 p refs
(Contract AF 04(694)-427)
(ASRL-TR-121-1; AD-612173)

A nonlinear method is proposed for predicting the airloads on a slender, pointed body of revolution due to indicial sinking at a large angle of attack at supersonic or low hypersonic speeds. The method is an extension of Miles (NAVORD 2052) linearized theory for a slender, pointed body achieved by incorporating the Bryson theory of the indicial drag of a circular cylinder for the transient cross-flow drag on the body. Comparisons of the steady-state theory are made with wind-tunnel data to indicate the range of Mach number, angle of attack, and fineness ratio over which the method could be expected to be applicable. It is found that the method is most useful for predicting the airloads on the cylindrical portion of the body, where vortices have the largest effect on the flow.
Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-21184# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON FLIGHT TECHNOLOGY [LITERATUUROVERZICHT, LUCHTVAARTTECHNIEK]
12 Jan. 1965 19 p refs In DUTCH *Its* 13th Yearly Issue, No. L-270

Brief reviews of papers on flight technology are described. Properties and achievements of flight, steering, airfields, navigation and regulation of air traffic, safety, aerodynamics, strength and underwater vibrations, and technical news are reported. L.S.

N65-21385# Central Experimental and Proving Establishment, Rockcliffe (Ontario).
EVALUATION OF LIGHTNING PROTECTION FOR ARGUS AIRCRAFT
D. A. Duston, comp. Mar. 1964 10 p
(CEPE-1727)

A program was instituted to provide modifications to the Argus aircraft to reduce damage caused by lightning. These modifications were evaluated in three phases: (1) Drawings for the prototype modifications were reviewed by LTRI from a theoretical viewpoint prior to fit to the CEPE aircraft and components as called up for the modifications were physically tested in the LTRI Laboratory. (2) Approved modifications were installed on Argus 20714 and a final review of these modifications was made by LTRI, CEPE and the AFHQ project officer. (3) The aircraft was then ferried to USN Station Mayport, Florida where it was system checked by LTRI. This program consisted of directing artificially generated lightning strikes at the aircraft. During these tests the aircraft was on the ground. These tests proved the effectiveness of the modifications in reducing damage to the aircraft caused by lightning strikes.
Author

N65-21408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATMOSPHERIC TURBULENCE AND THE STABILITY OF FLIGHTS IN ZONE OF TROPOPAUSE AND JET STREAMS
N. F. Gel'mgol'ts 23 Feb. 1965 44 p refs Transl. into ENGLISH from Tr. Kazakh. Nauchno-Issled. Gidrometeorol. Inst. (Leningrad), no. 19, 1963 p 3–30
(FTD-MT-64-297; AD-612366)

An analysis is made of atmospheric turbulence, experienced by an aircraft both as bumps and bumpy air. The general conditions and distribution of turbulence aloft, the relationship between prevailing and maximum overloads affecting an aircraft, and the frequency of overloads are investigated. Dependence of turbulence on geographic conditions on the stratification, type and slope of tropopause, wind speeds and jet streams, synoptic situation, and cloudiness are ascertained. Flights of IL-28 sounding aircraft of southeastern Kazakhstan are described. The range of the investigated heights is 8 to 12 km.
Author

N65-21409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATOMIC ENERGY AND AVIATION
A. P. Yermakov and A. G. Syrmay 12 Feb. 1965 19 p Transl. into ENGLISH from At. Energ. i Transp. (Moscow), 1963 p 101–114
(FTD-MT-64-415; AD-612368)

Possible future developments in supersonic air transport are reviewed. Since high landing speed is the chief drawback of supersonic passenger service, frequent landings can be avoided by transferring passengers in flight through special hatches to interceptor ferry aircraft from local airports, or by using the supersonic craft to tow local aircraft. Thus, very large aircraft could fly nonstop for several months at high altitudes over closed routes. The use of guiding plates in front of jet turbines for vertical takeoff and landing, and the idea of engineless gliding flight are also discussed. The advantages and disadvantages of open cycle and closed cycle atomic power are considered for turbojet, turboprop, and ramjet engines.

Size, weight, efficiency, biological shielding requirements, reliability, and structural materials problems are discussed generally. M.P.G.

N65-21451# International Civil Aviation Organization, Montreal (Quebec).
ACCIDENT INVESTIGATION DIVISION REPORT OF THE THIRD SESSION, MONTREAL, 19 JANUARY–11 FEBRUARY 1965
B. H. Larsen [1965] 85 p
(DOC.-8486, AIG/III)

Experts' recommendations to promote effectiveness of investigations of transport aircraft accidents are presented. The recommendations concern rapid and comprehensive notification of aviation authorities when an accident has occurred, provision of technical experts for consultation and advice, improved and more rapid dissemination of information on accidents and accident inquiries, specifications for immediate technical investigations following accidents, and movement of wreckage for examination. Assembly of an aircraft accident manual is discussed. J.M.D.

N65-21498# Boeing Co., Renton, Wash. Airplane Div.
METEOROLOGICAL ASPECTS OF THE SONIC BOOM Final Report
Edward J. Kane and Thomas Y. Palmer Sep. 1964 143 p refs
(Contract FA-WA-4717)
(RD-64-160; AD-610463) CFSTI: $4.00

The effect of changing meteorological conditions on the sonic boom produced during steady level flight is reported. The influence of variations in atmospheric temperature, pressure, and wind on this noise are investigated. Simplified methods are established for estimating the effect of these variations. Combinations of meteorological conditions which can produce anomalous propagation such as complete cutoff, focusing, and extreme lateral spread are discussed. The effect of air turbulence near the ground is considered. A number of comparisons with test data measured at Oklahoma City (1964) are presented, and recommendations for additional experimental and theoretical work are outlined. Author

N65-21742*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A VISUAL FLIGHT INVESTIGATION OF HOVERING AND LOW-SPEED VTOL CONTROL REQUIREMENTS
John F. Garren, Jr., James R. Kelly, and John P. Reeder Washington, NASA, Apr. 1965 18 p refs
(NASA-TN-D-2788) CFSTI: HC $1.00/MF $0.50

A visual flight investigation was conducted with a variable-stability helicopter to contribute toward a basis for establishing VTOL control requirements relative to control power and sensitivity. Control power is defined as the maximum angular acceleration which can be produced from a trimmed flight condition, and sensitivity is defined as the angular acceleration per inch of control. To permit variations in control power, independent of sensitivity, variable-control travel stops were located on the pitch, roll, and yaw controls. A variety of visual tasks were performed including forward, rearward, and sideward flight, quick starts and stops, roll reversals, and hovering turns. The angular velocity damping was held constant at the minimum value required by current specifications throughout most of the investigation. The simulation technique which was employed eliminated trim changes and resisted external angular disturbances. The results of this investigation indicated that control power was the primary factor which influenced the pilots' ratings of the aircraft's maneuverability whereas sensitivity had only a minor effect. For the performance of precision tasks, neither control power nor sensitivity had an appreciable effect on pilot rating for the range of parameters covered. Comparisions of the minimum satisfactory control power obtained for the maneuver tasks with current VTOL specifications indicated reasonably good agreement (between 3% and 20% for all axes). Author

N65-21855# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THEORY OF THE BALLISTIC NOISE CAUSED BY SUPERSONIC FLYING IN NON-HOMOGENEOUS ATMOSPHERE [THEORIE DUBRUIT BALISTIQUE PROVOQUE EN ATMOSPHERE NON HOMOGENE PAR LE VOL D'UN AVION SUPERSONIQUE]
Jean-Pierre Guiraud 1964 176 p refs In FRENCH; ENGLISH summary
(ONERA-TN-79)

The equations of the problem are established according to the acoustical approximation, and then a solution is contemplated at the same approximation order by using the elementary solution, of a normal hyperbolic operator. This solution is analyzed for the study of its asymptotic behavior in the zone of noise formed by the Mach conoids having their summits on the fuselage axis. The acoustical solution thus obtained is modified to include the nonlinear effects and the shock waves. The nonperturbed atmosphere is assumed to depend arbitrarily upon altitude without wind and the airplane flight path may be very general. Author

N65-21863# Royal Aircraft Establishment, Farnborough (England).
THE DRAG AND OPENING CHARACTERISTICS OF PARACHUTES OF SEVERAL DESIGNS WHEN TOWED BEHIND AN AIRCRAFT–THEIR CONSISTENCY AND COMPARISON WITH PREVIOUS DATA
A. J. Marsden London, Min. of Aviation, Oct. 1963 54 p refs
(RAE-TN-MECH-ENG-390)

The results of repeated towing tests on parachutes of several designs are discussed. The accuracy of the measurements is considered, and it is shown that errors of measurement do not account for all the variations obtained in the readings. A statistical analysis of the results was attempted, but it is concluded that there are insufficient readings available to prove that the frequency distribution about the arithmetic mean is normal. Therefore the readings are presented graphically. The different designs are compared for drag, opening characteristics, and lateral stability, and the effect on these characteristics of the turbulence behind the aircraft and the length and material of the strop is discussed. The variation of the performance of the parachutes with changes in test condition and parachute size is considered for the shaped and guide surface designs. Author

N65-21867# Royal Aircraft Establishment, Farnborough (England).
THE NET SKIRT EXTENSION ON MAN-CARRYING TYPE PARACHUTES
A. G. Jolly and G. W. H. Stevens London, Min. of Aviation, Sep. 1963 22 p refs
(RAE-TN-MECH-ENG-389)

A collective account is presented of four groups of tests on man-carrying-type parachutes fitted with a net extension to the skirt of the canopy. This modification was proposed as a means of preventing blown peripheries. Overall it is a successful modification, only one abnormality occurring in nearly a thousand tests, but the retention of a stiff seam, equivalent to the hem in construction, between the net and the main canopy

fabric is essential. A parachute in which the net and fabric are joined by a simple double seam has undesirable inflation characteristics and this fact accentuates the importance of the influence of apparently minor modifications on the performance of a parachute. The maximum speed at which standard flat parachutes can be safely inflated can be raised to that determined by the strength of the lines or the burst strength of the fabric. Author

N65-21870# Royal Aircraft Establishment, Farnborough (England).
THE DESIGN AND PERFORMANCE OF THE RIBLESS GUIDE SURFACE PARACHUTE
G. G. Gale London, Min. of Aviation, Nov. 1962 33 p refs
(RAE-TN-MECH-ENG-362)

An attempt was made to retain the truncated conical skirt and the flow breaking edge between the skirt and canopy top, and to simplify the number and shape of the panels of the ribbed design. Models of such a simplified design, known as the ribless stabilizing guide surface parachute, gave sufficiently promising results in the vertical tunnel to warrant larger sizes of similar design being manufactured for flight tests. Parachutes of 10 ft nominal diameter were included in a repeated performance program and although giving a good degree of uniformity, did not compare favorably with similar ribbed parachutes regarding steady drag. It was found that the canopy which was interhem-stitched, was not being equally stressed, and did not realize its nominal diameter when inflated. Repeat tests using hem-rigged parachutes gave a much improved performance. The general design and test results are described of a ribless stabilizing guide surface parachute; and its is concluded that as well as having less bulk and being easier and cheaper to manufacture, its performance, in all respects, compared favorably with that of the ribbed design of similar nominal diameter. Author

N65-21891# White Sands Missile Range, N. Mex. Inter-Range Missile Flight Safety Group
GUIDELINES FOR THE DEVELOPMENT OF MISSILE FLIGHT SAFETY SYSTEMS
Jan. 1965 8 p
(IRMFSG-302-63; AD-428045)

Presented are guidelines related to missile performance and test area conditions and designed to help decide the need for a safety system. Considered are mathematical methods and engineering details, the respective philosophies and policies, the geographical boundaries and limitations, the envelope of expected vehicle performance, and the ability to accept consequences of malfunctioning missiles, to make adequate performance measurements and to take actions which will change or minimize expected consequences. It is concluded that the design of a missile flight safety system is implied from concept to implementation, and the lack of any part of the system negates the need for the rest of it. G.G.

N65-21910# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
FLYING IN TURBULENT ATMOSPHERE [VOLS EN AIR TURBULENT]
Gabriel Coupry 1965 47 p refs In FRENCH; ENGLISH summary
(ONERA-TN-78)

New problems set by jet airplanes flying in turbulent air and particularly by the supersonic transport airplane, create a need for a mathematical model leading to a prediction of the risks to which such airplanes are exposed. The only statistical technique allowing achievement of such a goal is based on the RICE asymptotic formulas, and the atmospheric parameters which must be known are the power spectrum and the local mean square value. Results of flight tests agreed very well, in some domains, with the results given by the chosen mathematical model. Author

N65-21956# Royal Aircraft Establishment, Farnborough (England).
AN ESTIMATION OF THE OCCURRENCE AND INTENSITY OF SONIC BANGS
C. H. E. Warren London, Min. of Aviation, Sep. 1954 23 p refs
(RAE-TN-AERO-2334)

A rough investigation was made into the occurrence and intensity of sonic bangs. It is shown that the intensity depends mainly on the altitude of the aircraft; Mach number and aircraft size are relatively unimportant. Attention is drawn to the occurrence of localized bangs of increased intensity. The effects of refraction are considered: it is shown that for an aircraft in steady level flight at low supersonic speeds it is quite possible for no sonic bangs to be heard on the ground. No assessment is made of the nuisance or damage likely to be caused by sonic bangs, although formulas are given for estimating their intensities in a variety of cases. Author

N65-21961# Royal Aircraft Establishment, Farnborough (England).
FLIGHT HANDLING, RELEASE AND INSTRUMENTATION TRIALS OF A PARACHUTE TEST VEHICLE FOR PYLON CARRIAGE ON METEOR AND CANBERRA AIRCRAFT
G. G. Gale London, Min. of Aviation, Mar. 1962 52 p refs
(RAE-TN-MECH-ENG-345)

This report describes tests made to clear the parachute test vehicle, No. 7, for pylon carriage and release from both Meteor and Canberra aircraft under the load and speed conditions specified. It also describes the method of obtaining force-time traces with the RAE mechanical load recorder, as the parachute deploys and develops and the development of a static line system to initiate parachute deployment immediately on release of the vehicle from the pylon. From the relative positions of the vehicle and aircraft, recorded by a long focus ciné camera set at right angles to the release point and well away from the line of flight, a more accurate assessment of the actual deployment speed than that obtained previously, could be made. Author

N65-22035# Army Foreign Science and Technology Center, Arlington, Va.
"V-2" UNIVERSAL HELICOPTER
V. Zakharov Dec. 1964 7 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), Aug. 1964 p 20–21
(FSTC-381-T64-57; AD-611409)

The development of the "V-2" turboprop helicopter which carries seven to eight passengers and travels at maximum speed of 254 km/hr is reported. The new helicopter is capable of lifting a load up to a ton either within the cabin or on an exterior suspension device. The machine is equipped with a winch and boom for raising small loads into the cabin while hovering. It attains a height of 4000 m and can fly to its maximum range of 600 km in a few hours. Although considered a light helicopter, it approaches the medium MI-4 in all its indices, through the use of two turboprop engines which are smaller and lighter than piston-driven engines. The helicopter's reliability is more enhanced through using the two engines since it is able to continue its flight on one engine if the other fails. Speculation is made concerning the

use of this new helicopter as a special passenger helicopter, an ambulance for carrying doctors to disaster areas, geological surveys, and agricultural technology. Schematic drawings showing design features are also presented. S.C.W.

N65-22183*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC TESTS OF V/STOL TRANSPORT MODELS
M. O. Mc Kinney and R. H. Kirby [1964] 41 p refs Presented at the AIAA Transport Aircraft Design and Operations Meeting, Seattle, 10–12 Aug. 1964
(NASA-TM-X-51790) CFSTI: HC $2.00/MF $0.50

This paper summarizes results of dynamic tests of free-flight models of these configurations: tilt-wing propeller-driven type; fan-in-wing type, and jet-lift type. Propeller- and lift-fan-powered V/STOL transport types have dynamic stability problems in hovering and low-speed flight; these instabilities can be controlled by the pilot without the use of artificial stabilization. As the airspeed approaches that required for normal wingborne flight, these instabilities are markedly reduced and usually disappear. In the approach condition for the tilt-wing type, very poor dynamic behavior can result from the tendency of the wing to stall if the aircraft is not designed to avoid this difficulty; this poor behavior limits the descent angles that the pilot is willing to use. The jet V/STOL types have no real dynamic stability problems other than those associated with static stability and trim characteristics such as pitchup, directional instability, and excessive pitch trim requirements which can be determined by ordinary wind-tunnel tests. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-21179# Pennsylvania State Univ., University Park. Mineral Industries Experiment Station
FUEL CELLS Semiannual Progress Report, Jul.–Dec. 1964
L. G. Austin, H. Lerner, and S. Almaula [1964] 49 p refs
(Contract DA-49-186-AMC-146(D))
(AD-612276)

This report summarizes work performed on theoretical and experimental analysis of basic fuel cell data including continuation of other work on the mode of operation of porous electrodes. A number of literature abstracts prepared as part of the review program are presented. Author

N65-21225*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio.
SUNFLOWER TURBOALTERNATOR CSU I-3A, 4329-HOUR-TEST SUMMARY REPORT
Washington, NASA, Apr. 1965 133 p
(Contract NAS5-462)
(NASA-CR-169) CFSTI: HC $4.00/MF $1.00

Significant factors related to performance and endurance capabilities, including design factors, testing results, performance analysis, and posttest hardware inspection are reported. The causes of failure and recommendations for development improvements are made. In general, objectives established at the outset of testing were fulfilled with only one exception. Simulated squirt starts were precluded by an unexpected failure. Total accumulated run time of 4329 hours demonstrated an endurance capacity of design half-life. The forces of shutdown caused some damage to the journal bearings, especially in the case of the alternator bearing. However, the only change attributable to normal operation was an occasional 0.85-mil corrosion. In the case of the thrust bearings, there was no damage. No signs of wear, erosion, or dimensional changes could be found as a result of the operational test. The results of the CSU I-3A testing verified the findings of the CSU I-3 test. Both indicated that the basic CSU design is capable of meeting its design performance requirements but that further design refinements are required in certain areas. These modifications are discussed in detail. E.E.B.

N65-21260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF A CYCLONE SEPARATOR IN A NATURAL-CIRCULATION SYSTEM
B. A. Dement'yev, A. A. Loginov, and V. M. Ryabov 20 Jan. 1965 14 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 8, no. 5, 1961 p 52–57
(FTD-TT-64-683/1+2; AD-610327)

The results of determining the moisture of steam at the outlet of a cyclone machine as it depends on the steam load in the interval of pressure 9–33 abs. atm. are presented. An empirical formula is derived for determining the moisture of the steam issuing from the cyclone of the design. The data of the experiments are compared with precipitation separation of steam in volume. The dependence of the resistances of the separate sections of the cyclone on the load at different pressures is presented. Author

N65-21276*# Livingston Electronic Corp., Montgomeryville, Pa.
DEVELOPMENT OF A LOW TEMPERATURE BATTERY FOR SPACE PROBE APPLICATIONS Second Quarterly Report, 24 Sep.–23 Dec. 1964
William F. Meyers [1964] 34 p
(Contract NAS3-6009)
(NASA-CR-54292) CFSTI: HC $2.00/MF $0.50

The three phases of this work are to obtain 72-hour battery performance from liquid ammonia batteries over the temperature range −40° to −73° C; limited wet stand capabilities to +70° C; and cell performance at −90° C. Reproducible low temperature cell performance was accomplished at −63° C by the addition of small quantities of sulfur into the cathode of the magnesium–mercuric sulfate bobbin cell. The low temperature performance goal was exceeded with the magnesium–metadinitrobenzene couple by the use of a spiraled flat plate configuration. This cell also performed for the required time at +20° C to a slightly lower end voltage. Difficulties encountered with suitable cell containers or vehicles and environmental requirements were largely overcome, and an approach to reproducibility has been established. Author

N65-21283*# Cosmic, Inc., Washington, D. C.
EXPERIMENTAL EVALUATION OF ELECTROSTATIC GENERATOR CONFIGURATIONS Final Report
Dominique Gignoux and H. F. Anton Mar. 1965 57 p refs /*ts* Rept. No. 84
(Contract NAS3-6462)
(NASA-CR-54347) CFSTI: HC $3.00/MF $0.50

Two different designs of electrostatic generators of the same size were tested under the same conditions in air at atmospheric pressure. Ten arrangements of a constant oblique field, and three of a single capacitor are tested. For each configuration, a curve of short circuit current as a function of

excitation voltage and curves of output voltage versus output current for several values of excitation voltage are given. The power of the constant oblique field machine in air is about 200 times that of the single capacitor machine. Extrapolations to vacuum insulation and comparison with other experimental data are given. Author

N65-21286# General Electric Co., Lynn, Mass. Direct Energy Conversion Operation
FUEL CELL RESEARCH AND DEVELOPMENT: HYDROCARBON–AIR FUEL CELLS Semiannual Technical Summary Report No. 6, 1 Jul.–31 Dec. 1964
E. R. White et al [1964] 356 p refs
(Contracts DA-44-009-ENG-4909; DA-44-009-AMC-479(T); ARPA Order 247)
(AD-612766)

Detailed information is presented on a continuing research and development program to develop a direct hydrocarbon oxidation-air fuel cell technology. Current work included research on electrochemical oxidation processes, electrocatalysts, electrolytes, electrode structures, fuel cell life testing, and studies of self-sustaining operation. Multipulse potentiodynamic techniques have been further developed for analyzing hydrocarbon surface processes. Performance of fuel cell systems with hydrogen fluoride and cesium fluoride electrolytes was studied for high performance. Author

N65-21314*# Electro-Optical Systems, Inc., Pasadena, Calif.
CONDENSER HEAT REJECTION SYSTEMS Monthly Progress Report, 22 Apr.–26 May 1962
Lance Hays 10 Jun. 1962 3 p
(Contract NAS7-11)
(NASA-CR-57756; EOS-1588-ML-19) CFSTI: HC $1.00/MF $0.50

Testing of a multitube jet condenser unit was completed. The unit was operated with no vapor at the outlet and nearly uniform flow from tube to tube for flow conditions which resulted in values of vapor to liquid pressure rise approximately equal to or less than the dynamic pressure of the injected liquid. As higher values of pressure rise were attained, the unit exhibited oscillations in vapor flow from tube to tube and fluctuating outlet pressures. Test data are being reduced and correlated. Correlation of single unit jet condenser is nearly complete. L.S.

N65-21322*# Hoffman Electronics Corp., El Monte, Calif. Semiconductor Div.
INTEGRAL GLASS COATINGS FOR SOLAR CELLS Final Report, 4 May–4 Nov. 1964
Peter A. Iles [1964] 91 p refs
(Contract NAS5-3857)
(NASA-CR-57963) CFSTI: HC $3.00/MF $0.75

Cells with conversion efficiencies up to 10%, in airmass zero solar illumination, were made in development quantities. The glass-layer thickness could be varied from 2μ to 20 mils. The methods developed show considerable promise, particularly for space missions where very-light-weight passive thermal control is required, and where the radiation environment consists mainly of low-energy particles. The feasibility of coating production quantities of cells was demonstrated. Author

N65-21346*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Sep. 1–30, 1962
L. Yang, A. F. Weinberg, F. D. Carpenter, and R. G. Hudson [1962] 20 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57899; GACD-3760) CFSTI: HC $1.00/MF $0.50

An all-metal cell for testing the vaporization and emission of UC–ZrC and W-clad UC systems in the presence of cesium vapor is being fabricated. High temperature property studies include density effects on the rate of vaporization and electron emission of UC–ZrC in vacuum, fabrication of a cell for redeposition, and design of a thermionic emission microscope. A capsule for studying dimensional stability and fission gas release behaviors of UC–ZrC and W-clad UC upon irradiation at high temperatures is being designed. The $UMoC_2$ and UC–ZrC cathodic materials containing a small amount of cerium and thorium carbides were prepared for vacuum emission study, and various techniques are being investigated for producing W-clad UC emitters. L.S.

N65-21347*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Oct. 1–31, 1962
L. Yang, A. F. Weinberg, F. D. Carpenter, and R. G. Hudson [1962] 15 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57897; GACD-3825) CFSTI: HC $1.00/MF $0.50

Vaporization and emission tests of UC–ZrC and W-clad UC systems in the presence of cesium vapor and studies of high-temperature properties of UC–ZrC are being conducted. Work on fabricating an instrument panel for controlling capsule temperatures during irradiation was started. Also being investigated are emission and diffusion of new cathode materials. Carbide cathodes are being fabricated by cold-pressing-sintering techniques, and cylindrical UC bodies are being clad with tungsten by thermochemical decomposition. L.S.

N65-21348*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Dec. 1–31, 1962
L. Yang, A. F. Weinberg, F. D. Carpenter, and R. G. Hudson [1962] 25 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57895; GACD-3960) CFSTI: HC $1.00/MF $0.50

Long-term tests of the vaporization and emission of UC–ZrC and W-clad UC in cesium vapor, and studies on the high-temperature properties of UC–ZrC, irradiation, and new cathode materials are reported. The cell for the vaporization of UC–ZrC in cesium vapor was modified to allow a W–W26Re thermocouple to stay in contact with the carbide sample surface during the run so that the pyrometer reading of the sample temperature can be checked. The modified cell was tested in vacuum. Also, the first cell for the study of emission stability of UC–ZrC and W-clad UC in cesium vapor was assembled and tested for thermal characteristics during vacuum operation. The cell operated successfully but developed leaks on cooling due to the overheating of the ceramic seal and brazed joints. Cooling fins were added to overcome these difficulties. The vacuum emission of 90UC–10ZrC, 86% dense was found to be lowered slightly, presumably due to excess metal removal in the sample by vaporization. E.E.B.

N65-21349*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Jan. 1–31, 1963
L. Yang, A. F. Weinberg, F. D. Carpenter, and R. G. Hudson [1963] 25 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57898; GACD-4008) CFSTI: HC $1.00/MF $0.50

Rates of vaporization of sample 90% UC–10% ZrC nominal at a cesium pressure of 1.8 torr were measured. Cooling fins were added to critical areas of carbide cells being tested for emission stability. Porosimetric investigations for vacuum emission were made on various UC–ZrC samples, and physical redeposition studies using a UC cathode and Mo anode are being conducted. Emission patterns from a thermionic emission microscope are being correlated with patterns observed under an optical microscope. An unclad carbide capsule for irradiation was assembled, which had the configuration and shape of previously assembled clad capsules. Neutronic and heat-transfer data are being calculated. Various methods for fabricating clad carbide samples are given, and vacuum emission and vaporization rates were measured for new cathode materials. L.S.

N65-21350*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Jun. 1–30, 1963
L. Yang, A. F. Weinberg, F. D. Carpenter, M. H. Horner, R. G. Hudson et al 5 Aug. 1963 21 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57900; GACD-4457) CFSTI: HC $1.00/MF $0.50

Two cells, one containing a 30% UC–70% ZrC sample and the other containing a 90% UC–10% ZrC sample are in operation for vaporization testing in cesium vapor. Condensates from physical redeposition runs of UC, 30% UC–70% ZrC and 90%–10% ZrC cathodes versus Ni anode were analyzed for uranium and zirconium contents. The poisoning and regeneration of the electron emission of a hyperstoichiometric UC sample show similarity between the emission pattern and microstructure of the sample. Hot cell examinations of samples in the unclad carbide capsule has been started, and the clad capsule is being irradiated in the reactor. The vacuum emission of a 30% UC–70% NbC sample was measured and the vacuum rate of vaporization of a 30% UC–70% TaC sample is in progress. Diffusion runs of Ir, Re, and W–26% Re versus hyperstoichiometric 30% UC–70% ZrC were made, and diffusion-emission studies of vapor-deposited W-clad UC (4.70 wt-% C) and 30% UC–70% ZrC samples are in progress. L.S.

N65-21351*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Jul. 1–31, 1963
L. Yang, A. F. Weinberg, F. D. Carpenter, R. G. Hudson, J. R. Lindgren et al 16 Aug. 1963 19 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57896; GACD-4508) CFSTI: HC $1.00/MF $0.50

Cells containing samples 30% UC–70% ZrC and 90% UC–10% ZrC operating for 294 hrs and 335 hrs, respectively, in cesium vapor at 1.8 torr pressure showed no appreciable effect of cesium vapor on the rate of vaporization. Measurements on the rate of vaporization of a 30% UC–70% ZrC sample of better than 95% theoretical density are used to study porosity effects. Chemical redeposition studies using CaF additives are being initiated. Hot cell examinations of the contents of an unclad carbide capsule, the irradiation of a clad capsule for one cycle in GETR, and vacuum rate of evaporation studies of a 30% UC–70% TaC sample were completed. Metallographic examinations on samples from a diffusion run of 30% UC–70% ZrC vs. Ir, Re, and W–26% Re at 1800° C for 24 hours were made, and diffusion-emission studies of samples vapor-deposited, W-clad metal-rich UC and vapor-deposited, W-clad 30% UC–70% ZrC are being continued. L.S.

N65-21353*# Oklahoma State Univ., Stillwater. Fluid Power and Controls Lab.
STUDY OF FLUID TRANSIENTS IN CLOSED CONDUITS Progress Report No. 64-5, 1–30 Nov. 1964
J. D. Parker and C. R. Gerlach 7 Dec. 1964 23 p refs
(Contract NAS8-11302)
(NASA-CR-57892) CFSTI: HC $1.00/MF $0.50

The simple case of a one-dimensional conduit with no friction loss is considered in a distributed-parameter model represented by the equation of motion and by the continuity relation for a liquid; the assumption is made that the compressibility is lumped at $z = 0$ and that the mass is also lumped. It is concluded that a lumped-parameter model is good only for relatively low frequencies that are not greater than one-eighth of the first critical frequency of the system. Solutions by the analog method were used to simulate a lumped-parameter model of a conduit system. The major experimental effort was the completion of the first experimental apparatus consisting of a conduit with a constant pressure reservoir at one end and an oscillating piston at the other end, which makes it possible to reach the second critical frequency with some fluids. An approximate approach to solve the time varying longitudinal deflections of tubes is presented, and work was started on the development of a transient, two-phase fluid conduit model. The velocity of sound in a two-phase mixture was analyzed and found much lower in the liquid phase, and lower in the vapor phase. G.G.

N65-21378*# Naval Ammunition Depot, Crane, Ind.
EFFECT OF STERILIZATION ON SEALED NICKEL CADMIUM CELLS FOR USE IN SPACE SATELLITES
E. R. Pettebone and C. M. Austin [1964] 31 p
(NASA Order S-23404-O)
(NASA-CR-57876; QE/C-64-130) CFSTI: $2.00/MF $0.50

A series of six sealed nickel–cadmium batteries were tested to determine the effect of sterilization on battery performance. Each battery consisted of five hermetically sealed 3.0-ampere hour D cells, connected in series and uniformly spaced in a plastic rack. Two of the batteries were sterilized by heating to 135° C for 48 hours. The batteries were cycled at either 10° or 40° C for 2000 cycles at ambient pressure. For each battery the data presented by cycle number include ampere hour and watt hour efficiencies, initial and final ampere hour discharge and NAD Crane values, watt hour input and output, and end of charge and discharge cell voltages. A wiring diagram for the sterilization cycling program is shown. J.M.D.

N65-21389*# Lockheed-California Co., Burbank.
STUDY FOR AN ON-BOARD ELECTRICAL POWER SYSTEM FOR A MANNED ORBITAL SPACE STATION Condensed Summary Report, 6 May–6 Nov. 1963
25 Nov. 1963 16 p
(Contract NAS9-1307)
(NASA-CR-62103; LR-17421) CFSTI: HC $1.00/MF $0.50

Conceptual designs were prepared for solar photovoltaic power systems using n-p silicon solar cells and silver–cadmium batteries for energy storage, and for solar dynamic systems using thermal energy storage and Rankine, Stirling, and Brayton cycle engines. Two SNAP-8 reactor systems were considered, using Rankine and Brayton cycle engines, as well as a bank of strontium 90 radioisotope capsules with a Brayton cycle engine. The candidate solar and nuclear systems were compared and evaluated on the basis of weight, cost, availability, reliability, logistic requirements, and influence on space station design and operation. A major obstacle to objective comparison is the wide disparity in development status of the candidate systems. The study indicates that solar photovoltaic systems will probably be chosen for many spacecraft during the next ten years. E.P.V.

N65-21391*# Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Progress Report, Jan. 1963
J. J. Rowlette 8 Feb. 1963 9 p
(Contract NAS7-181)
(NASA-CR-62104; EOS-3310-ML-5) CFSTI: HC $1.00/MF $0.50

Experimentation on electrolyte concentrations, electrolyte storage, and charge retention is reported. Numerous attempts to duplicate the original results of the effect of KOH electrolyte dependence on cell polarization have verified some features of that work, but the low cell polarization at high current densities with 10% KOH have not been observed. Recent experiments were made with a cell containing reference electrodes, whereas former ones were not. Results of a series of measurements of electrode polarizations for 10%, 35%, and 55% KOH are shown. The importance of electrolyte concentration on cell performance lies in the fact that a rechargeable hydrogen–oxygen cell must operate over a wide concentration range. In the electrolyte storage experiments it was shown that the electrolyte stored in the region behind the electrodes is available for use in the cell. The total weight of 35% KOH in the cells was 6.2 gm. The total amount of electrolyte stored in the cell, exclusive of that behind the electrodes, was enough for only 3.4 A-h. By multiplying A-h/gm by 6.2, all values exceed 3.4 A-h. E.E.B.

N65-21423*# Westinghouse Electric Corp., Baltimore, Md.
INVESTIGATION OF THIN DIELECTRIC FILMS FOR ENERGY CONVERSION Quarterly Report No. 3
15 Mar. 1965 53 p refs
(Contract NAS2-1995)
(NASA-CR-62132; A-51255-AA-1A) CFSTI: HC $3.00/MF $0.50

A thermoelectrostatic energy conversion circuit was developed for high-efficiency, continuous solar energy conversion in a rotating satellite that demonstrated experimentally output–input energy ratios of up to 2.22 with composite films. The capacitance for the working condenser was less than one-twentieth of that of the output condenser. A low-frequency bridge was employed to make capacitance measurements on a number of homogenous and composite dielectric films. Composite films showed significant capacitance changes close to the room-temperature ambient and in the lower temperature ranges in contrast to the behavior of homogenous films. A thermally generated voltage was discovered in single and composite films that survived subjection to a vacuum of 5×10^{-5} torr and storage. A derivation of the expected energy conversion ratio for the thermoelectrostatic cycle was developed that permits the choice of suitable materials and dielectric constant ratios. G.G.

N65-21432*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
AN EXPERIMENTAL MODEL OF A 2KW, 2500 VOLT POWER CONVERTER FOR ION THRUSTORS USING SILICON TRANSISTORS IN A PULSE-WIDTH-MODULATED BRIDGE INVERTER Summary Report
G. W. Ernsberger 1 Mar. 1965 72 p
(Contract NAS3-5918)
(NASA-CR-54217; WAED65-12E) CFSTI: HC $3.00/MF $0.75

Two power supply models were built and evaluated. The test program demonstrated that using silicon power transistors in a pulse-width modulated bridge inverter with current-feedback base drive is an effective and desirable method of building a reliable, lightweight, and efficient power converter for ion thrustors. Author

N65-21557# Lockheed Aircraft Corp., Sunnyvale, Calif. Materials Sciences Lab.
LITHIUM–SILVER–CHLORIDE SECONDARY BATTERY INVESTIGATION Final Technical Report, Dec. 1963–Nov. 1964
J. E. Chilton, Jr., W. J. Conner, G. M. Cook, and R. W. Holsinger Feb. 1965 108 p refs
(Contract AF 33(615)-1195)
(AFAPL-TR-64-147; AD-612189)

Aluminum cases for housing the lithium–silver chloride nonaqueous electrolyte cell system were prepared using an improved seal assembly technique. Propylene carbonate electrolyte conductivity may be increased by the addition of solvents such as ether and toluene. The electrodeposition of propylene carbonate LiCl and $AlCl_3$ occurs at high efficiency. Silver chloride electrodes have been prepared by pasting a mix of 75% AgCl and 90% AgCl with 10% acetylene black. Cell heat measurements yield thermodynamic values for the postulated cell reaction of free energy, heat of reaction, and entropy which are within experimental accuracy equal to the theoretical values calculated for the following cell reaction with cell reactants and products in solid state: Li + AgCl yields LiCl + Ag. Lithium–silver chloride cell cycle life is improved at high temperature. A cell was constructed with electrodes sealed in a polyethylene case which had an energy density of 88 watt-hr/lb at 0.22 ma/sq cm current density. TAB

N65-21566# Caribbean Trading Corp., Fort Lauderdale, Fla.
LOW TEMPERATURE BATTERY (NEW MAGNESIUM ANODE STRUCTURE) Second Semiannual Report, 1 Apr.–30 Sep. 1964
Rodolfo R. Balaguer 31 Oct. 1964 51 p
(Contracts DA-36-039-AMC-00021(E); DA-36-039-AMC-03369(E))
(Rept.-4; AD-458861)

Investigations of shelf life and low-temperature performance consisted principally of two shelf and two experimental design programs. Investigations of anode pitting and slow voltage recovery of the cell comprising seven screening programs, involving various modifications and combinations of cell components, were undertaken. Pickling of the anode after forming minimized the pitting. The plastic cell closure has markedly improved the shelf life of the Balaguer D size cell. Employing a seamless steel jacket in place of a seam steel jacket reduced the radial expansion during cell discharge. Author

N65-21568# Wisconsin Univ., Madison. Solar Energy Lab.
PHOTOVOLTAIC POWER SYSTEMS USING HIGH SOLAR ENERGY FLUXES Quarterly Progress Report, Sep. 1–Nov. 30, 1964

P. Schoffer, W. Hartman, and W. Beckman [1964] 25 p refs
(Contract DA-28-043-AMC-00005(E))
(QPR-3; AD-458879)

Data are presented on cells with three different diffusion times operating with solar fluxes up to 35 W/cm^2 and temperatures up to 90° C. It is shown that by increasing the number of gridlines from 15/cm, as used in the experimental program, to 20/cm, a theoretical increase in the cell efficiency of 10% can be expected at a radiation level of 32 w/cm^2. The cell efficiency at this radiation level will probably be between 5% and 6%, but due to the normal cell variations it cannot be predicted more precisely. The use of a 1.8-meter-diameter solar concentrator is discussed. This collector consists of individually adjusted mirrors and will enable the breadboard system to produce 50 W even if the final array has the lowest expected efficiency. The difficulties encountered in obtaining efficient auxiliary equipment for the heat transfer system are discussed. Author

N65-21626*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT Quarterly Progress Report No. 6 for the Period Ending Jan. 15, 1965
E. E. Hoffman, ed. 12 Mar. 1965 60 p refs
(Contract NAS3-2547)
(NASA-CR-54344) CFSTI: HC $3.00/MF $0.50

The development of a prototype corrosion test loop for the evaluation of refractory alloys in boiling and condensing potassium environments which simulate projected space electric power systems is considered. Loop I, a natural convection loop, was operated for 1000 hours with liquid sodium at a maximum temperature of 2260° to 2380° F to evaluate the electrical power vacuum feedthroughs, the thermocouples, the method of attaching the electrodes, the electrical resistivity characteristics of the heater segment, and the use of thermal and electrical insulation. Loop II, a single-phase sodium, forced-circulation loop to evaluate the primary loop EM pump, a flowmeter, the flow control and isolation valves, and the pressure transducers completed 2650 hours of scheduled testing. This loop operated at a pump inlet temperature of 1985° F. Residual sodium was distilled from the loop and component evaluation initiated. The prototype corrosion test loop, a two-loop Cb-1Zr system, was designed and partially fabricated. It will include a boiler, turbine simulator, and condenser. This facility will be used to develop and endurance test (2500 hours) the components required to achieve stable operation at the corrosion test design conditions. R.W.H.

N65-21639*# Electro-Optical Systems, Inc., Pasadena, Calif.
BRAYTON CYCLE SOLAR COLLECTOR DESIGN STUDY
D. E. Stewart Washington, NASA, Apr. 1965 235 p refs
(Contract NAS3-2782)
(NASA-CR-195) CFSTI: HC $6.00/MF $1.25

This study has developed parametric analysis of 20- and 30-foot one-piece electroformed mirrors, conceptual designs and manufacturing methods for these concentrators, predicted concentrator performance, analysis of structural integrity, and experimental studies of master fabrication techniques and reflectance samples subjected to simulated micrometeorite damage. Experimental studies have demonstrated that either blade grinding or plastic overlay master fabrication techniques are amenable to the fabrication of high-accuracy, highly specular, collector masters. Author

N65-21656*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POWER STUDY OF SPIN STABILIZED EGO (S-49)
H. Montgomery and F. B. Shaffer Mar. 1965 13 p refs
(NASA-TM-X-55186; X-643-65-14) CFSTI: HC $1.00/MF $0.50

An analysis is performed to determine the solar array angle which will provide maximum power output for the Orbiting Geophysical Observatory satellite. Considered are the effects of shadowing by the box and deviation of solar cell short circuit current from a cosine curve. It is assumed: (1) The geometry of the satellite is given. (2) The satellite is spinning about the $\bar{k}_B$ axis. (3) The solar cells have uniform input-output behavior. (4) The deviation of the output from a cosine curve as the angle of incidence of sunlight is varied. Equations for the ratio of average to maximum current generated by the solar array are given. The possible ranges for the angle between the satellite's $\bar{k}_B$ axis and the vector which points from the satellite to the sun, and for the solar array angle are 0° to 180° and 90° to 270°, respectively. G.G.

N65-21674# Rocketdyne, Canoga Park, Calif.
HIGH-ENERGY BATTERY SYSTEM STUDY Fifth Quarterly Progress Report, 1 Jul.–30 Sep. 1964
J. Farrar, R. Keller, C. J. Mazac, and M. M. Nickolson [1964] 26 p refs
(Contract DA-36-039-AMC-03201(E))
(R-5405-5; AD-458472)

A new rectangular cell with more practical geometry and more uniform current density was constructed. Utilization efficiencies for lithium anodes were determined in this cell with lithium bromide in propylene carbonate and dimethyl sulfoxide as electrolytes. In the latter case, 90% efficiency was obtained. An improved electrode holder suitable for utilization measurements on powdered cathode materials was also developed and tested experimentally. The water absorbed by lithium bromide solutions in propylene carbonate and dimethyl sulfoxide during controlled exposure to moist air was determined, and the effect of this increase in water content on the behavior of silver oxide cathodes was investigated. Cathode performance is the greatest limitation to development of a complete cell with the desired energy density. Author

N65-21754# Case Inst. of Tech., Cleveland, Ohio.
FLUID AMPLIFICATION. 13: FLUID ANALOG TO DIGITAL CONVERSION SYSTEM
James N. Wilson (Ph.D. Thesis) Washington, Harry Diamond Labs., 30 Dec. 1964 83 p refs
(Contract DA-49-186-AMC-79(D))
(AD-613704)

The design and development of a fluid analog to a digital conversion system are described. The system represents the digital portion of an incremental fluid control system, and consists of a fluid quantizer, direction-sensing circuit, and four-stage binary bidirectional counter. The system operates at over 100 pulses per second. A method of quantizing an analog quantity, using a fluid as the information transmission medium, is examined and evaluated. The design of suitable fluid logic elements is described. Techniques are developed by which characteristics of these elements can be exploited for logic circuit synthesis. An engineering model is developed for predicting the dynamic characteristics of bistable fluid amplifiers. The dynamic behavior predicted by the model, in conjunction with experimental data, is used in discussing the factors that effect the speed of operation of logic circuits. Methods by which the speed of operation of logic circuits can be increased are also outlined. Author

N65-21893# Magna Corp., Anaheim, Calif. Research and Development Div.
BIOCHEMICAL FUEL CELLS Tenth Quarterly Progress Report, 1 Oct.–31 Dec. 1964
J. M. Brake [1964] 30 p refs
(Contract DA-36-039-SC-90866)
(Rept.-10; AD-460795)

A 45% increase in current density was obtained by circulating the formate fermentation mixture through a perforated electrode, instead of using a static system. A current density of 19 mA/cm^2 at a polarization of 0.15 V was obtained from a 0.03 *M* formate fermentation mixture at pH 1. The open circuit potential at this pH is −0.25 V vs SCE. A new formic acid analysis, suitable for use with small amounts of fermentation mixtures, was developed. It consists of two steps, vacuum distillation to separate the formic acid from interfering compounds, and oxidation to CO_2 with $Pb(OAc)_4$ to determine formic acid in the distillate. Author

N65-21896# General Electric Co., Waynesboro, Va. Electrical Systems Operation
MISSIONS AND POWER SUBSYSTEMS STUDIES Third Quarterly Report, 1 Jan.–1 Apr. 1965
John T. Radecki 15 Apr. 1965 70 p refs
(Contract AF 33(615)-1604)
(Doc.-65SD4274; AD-460816)

Methods for determining weight penalties imposed on total vehicle weight by losses in the distribution power of various distribution systems and power configurations are presented, and some examples are discussed. A comparative analysis of an ac distribution system and penalty weights indicated that variations in total distribution system weight are negligible for feeder temperatures between 270° and 800° F. Variations in the 3200-cps generator frequency will not affect feeder weights. Development of transformer parametric data relating weight, frequency, temperature, efficiency, and output voltage over a rating of 10 to 300 kVa for a three-phase liquid metal cooled transformer indicated that lowest transformer ratings are attained with high temperature and frequency, and some examples of these results are provided. In evaluating dc power distribution systems, an analysis of rectification components for installation at or near the generator showed optimum results for silicon diodes at a generator frequency range of 400 to 3200 cps. The use of high voltage three-phase ac feeders or high voltage dc feeders for two different missions was evaluated. G.G.

N65-22073# Mallory Battery Co., Tarrytown, N. Y.
TESTING AND EVALUATION OF PRIMARY ALKALINE CELLS AND BATTERIES Eighth Semiannual Report, 31 Jan.–31 Jul. 1964
Roger Goodman [1964] 34 p refs
(Contract DA-36-039-SC-78320(E))
(Rept.-8; AD-460578)

Delayed discharge test results are presented for cell types 1R at 24 months, 42R at 24 months, 502R at 24 months, 625R at 18 and 24 months, 640R at 36 months, 650R at 12 months, 1438R at 12 and 18 months, and 1450R at 24 months. Testing was completed for the 1000-hour rate of discharge for cell type 42R after 36 months of storage. Testing for initial and one month cyclic temperature storage for cell types 12R, 625R, and 640R was accomplished. Monthly EMF readings were taken for the six cell types remaining in this part of the program. Author

N65-22103*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT ON FUEL CELL SYSTEMS First Quarterly Progress Report, Period Ending Sep. 30, 1964
J. L. Platner 20 Jan. 1965 50 p Revised
(Contract NAS8-2696)
(NASA-CR-59455; NAS-8-2696-QPR-00001) CFSTI: HC $2.00/MF $0.50

Effort was directed toward fabrication and verification of a 1800-watt; 29 ±2-volt, fuel cell breadboard system. An existing 1.5-kW fuel cell breadboard system was dismantled and inspected and design specifications were reviewed. A summary of the tests on the 1.5-kW unit is included. Design modifications made permit an increase in the rating of the design to 28 volts at 1800 watts. Refurbishing of the breadboard system was completed. Expanded and extended research and development on fuel cell systems was accomplished. Coordinated plans for the three task parts, PERT schedules, organization diagrams, definitions of responsibilities, laboratory procedures, and documentation requirements, were submitted. A series of two-cell tests were made of various cell constructions; an evaluation of these tests is included. Results of preliminary testing of a breadboard model of an electronic controller for a vapor pressure regulator are also reported. Author

N65-22118# Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL STUDIES OF NOISE SUPPRESSORS FOR GENERAL MARINE VENTILATORS
V. F. Lyusov 29 Apr. 1965 12 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 2, Feb. 1960 p 29–33 (JPRS-29823; TT-65-30852) CFSTI: $1.00

Noise suppressors employing sound absorbent unions are recommended for effective sound attenuation in ventilators where the sound penetrates the installation along the air ducts of a ship's ventilation system. Comparison between the sound absorbent union-type suppressor, honeycomb suppressor, and chamber-type suppressor, shows that besides being smaller in size and weight, sound absorbent union-type suppressors exhibit a low degree of aerodynamic resistance. The thermal insulating materials VT_4 and asbestos "pukhshnur" are recommended as sound absorbent materials for noise suppression in general marine ventilation systems. Thickness of the sound absorbent layer and length of the noise suppressor were determined; 50 millimeters is the recommended thickness of the absorber, and 3 to 4 calibers, length for the suppressor. Belov's formula was used to establish the relationship between sound weakening in the suppressor, suppressor dimensions, and acoustic absorptivity. S.C.W.

N65-22170*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Second Quarterly Report, 21 Nov. 1964–20 Feb. 1965
S. Naiditch [1965] 36 p
(Contract NAS7-326)
(NASA-CR-62348) CFSTI: HC $2.00/MF $0.50

The objective is to evaluate the applicability of dense gaseous electrolytic solutions to energy conversion. Ammonia is used as the gaseous solvent. The experimental studies are being carried out in hermetically sealed glass vessels. Since the gaseous solvents are at pressures of the order of 112 atmospheres, external pressure is used to prevent rupture of the glass. The main features of the cell design are summarized. Author

N65-22172*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
LOW VOLTAGE DC TO DC CONVERTER–REGULATOR WITH MINIMUM EXTERNAL MAGNETIC FIELD DISTURBANCE First Quarterly Progress Report, 1 Jun.–30 Aug. 1964
John T. Lingle and Kenneth J. Jenson [1964] 51 p refs
(Contract NAS5-3899)
(NASA-CR-62352) CFSTI: HC $3.00/MF $0.50

Mathematical analysis of magnetic field disturbances on a choke coil design established that a single-section choke with enclosed coil and airgap will produce a 1.32 gamma magnetic field disturbance at 18 inches. Use of a dual section choke in a bucking arrangement reduced the disturbances to 4% of the specification requirement. An easily assembled coaxial power oscillator and associated transformers have been designed, with emphasis on concentricity and symmetry to minimize external magnetic field disturbances. Generation of the drive power for the chopping transistor by means of a current transformer in series with the secondary windings on the output transformer, and the positioning of a transistor and a diode in the back-bias circuit for the pulse-width modulator enhanced circuit performance. Improvement of the power oscillator switching speed showed promise in initial experiments. A circuit stress analysis is underway. Nonmagnetic materials and components have been found for most circuit parts. G.G.

N65-22173*# Naval Ammunition Depot, Crane, Ind.
NASA SPACE CELL TEST PROGRAM Monthly Progress Report, Period Ending 31 Mar. 1965
E. R. Pettebone and V. Yeager [1965] 114 p
(NASA Order W-11252-B)
(NASA-CR-62353) CFSTI: HC $4.00/MF $0.75

Life cycle tests for nickel cadmium (10 cell packs), nickel cadmium (5 cell packs), silver cadmium (10 cell packs), and silver zinc (5 cell packs) are reported. Also, the test parameters are listed. Test data sheets give end of discharge and end of charge voltage readings for each cell on each cycle. Prior to cycling, each pack was given a capacity test at its respective cycling temperature. This check consisted of a c/10 charge for 16 hours followed by a c/2 discharge to 1.0 volt/cell average. After each 88 days of cycling, each pack was discharged at the c/2 rate to 1.0 volt average following a charge at the cycle rate. The pack was then recharged at the c/10 rate for 16 hours and discharged at the c/2 rate to 1.0 volt/cell average. The pack was then recharged at the c/10 rate for 48 hours, voltage limited to the cycle limits. E.E.B.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-21159*# Texas Inst. for Rehabilitation and Research, Houston.
THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART VIII: THE EFFECT ON THE CARDIOVASCULAR TOLERANCE TO PASSIVE TILT
C. Vallbona, D. Cardus, F. B. Vogt, and W. A. Spencer Washington, NASA, Apr. 1965 100 p refs
(Contract NAS9-1461)
(NASA-CR-178) CFSTI: HC $4.00/MF $0.75

This study was carried out to evaluate the effect of short-term (3 days) and long-term (14 days) bedrest on the cardiac tolerance to passive tilt. It showed that there was a deterioration of the subjects' ability to tolerate passive tilt. The deterioration was demonstrated by the negative slopes of the regressional line of blood pressure vs time and the positive slopes of heart rate vs time observed during tilt procedures at the end of the period of bedrest. The intolerance to tilt was more evident after bedrest for 14 days. This study showed also that isometric exercises performed while on bedrest improved the subjects' tolerance to passive tilt, as evidenced in the slopes of blood pressure, which although negative were less steep. Author

N65-21181# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
DETERMINATION OF ENVIRONMENTAL AND FOOD-CHAIN RADIOACTIVE CONTAMINATION LEVELS—A GENERAL APPROACH
G. Lacourly Brussels, EURATOM, 1964 7 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-003-63-10 PSAF)
(EUR-2107.f) Available from Belg. Am. Bank and Trust Co. New York, Account No. 22.186: 25 Belg. Fr.

Assuming a steady and uniform contamination leading to a state of equilibrium in soil, this paper describes a general method to determine for a certain population and for each radionuclide having an affinity for the food chain in the critical diet corresponding to a given irradiation dose rate: the corresponding levels of radioactive contamination for each food vector; and the corresponding levels of environmental radioactive contamination. Author

N65-21186# Argentina. Comision Nacional de Energia Atomica Buenos Aires.
ABSORPTION OF RADIOACTIVE WASTE PRODUCTS BY AQUATIC PLANTS [INCORPORACION DE PRODUCTOS DE FISION EN PLANTAS ACUATICAS]
Dan Beninson, Eric Vander Elst, and David Cancio 1964 14 p refs In SPANISH
(Rept.-138)

A laboratory study was made of the absorption of radioactive fission products by various aquatic plants found in the small rivers of Buenos Aires Province, Argentina, in connection with the planned installation of a nuclear reactor in that area. The concentrations of strontium 90, cesium 137, cerium 144, lanthanum 140, ruthenium 106, and zirconium 95 in five plants were measured. Transl. by F.E.R.

N65-21202# Technisch Documentatie en Informatie Centrum voor De Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON MILITARY MEDICINE [LITERATUUROVERZICHT, MILITAIRE GENEESKUNDE]
15 Jan. 1965 21 p refs In DUTCH *Its* 11th Yearly Issue, No. G-119

Abstracts on aerospace medicine, military medicine and hygiene, psychology and psychiatry, and radiation medical physics are presented. Among the subjects covered are (1) systematic absorption of radioactive sodium in fresh and healing traumatic wounds; (2) absorption of radioactive fallout products through normal skin, burns, and open wounds; (3) acute radiation syndrome in domestic animals; (4) electroencephalography in aviation medicine; (5) ozone in high-altitude aircraft cabins; (6) airplane noises; (7) aircraft accidents; (8) combat fatigue; (9) factors associated with psychiatric discharge from the naval service; (10) infection of the urinary tract in young men; (11) influence of army service on the

incidence of carriers of Staphylococcus aureus and Streptococcus pyogenes; (12) aging in the Royal Navy; (13) thermal comfort in a small warship; and (14) underwater diving accidents. E.E.B.

N65-21208# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEDICAL RADIOLOGY Selected Articles
11 Jan. 1965 27 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 9, no. 3, 1964 p 52–66
(FTD-TT-64-7461/1+2; AD-610300)

CONTENTS:

1. STATE OF THE ORGAN OF VISION UNDER THE EFFECT OF γ NEUTRON RADIATION IN DOSAGES CLOSE TO MAXIMUM PERMISSIBLE E. N. L'vovskaya and E. S. Kotova p 1–7 refs (See N65-21209 11-04)

2. DOSAGE CHARACTERISTICS AND PECULIARITIES OF BEING AFFECTED DURING EXPOSURE OF MICE TO γ-IRRADIATION OF A DOSAGE POWER OF 48 kg/min L. B. Koznova p 8–15 refs (See N65-21210 11-04)

3. HISTOCHEMICAL CHANGES IN LEUKOCYTES AT EXPERIMENTAL RADIATION ILLNESS V. A. Almazov, T. L. Rogova, and E. A. Ruppe p 16–24 refs (See N65-21211 11-04)

N65-21209 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATE OF THE ORGAN OF VISION UNDER THE EFFECT OF γ NEUTRON RADIATION IN DOSAGES CLOSE TO MAXIMUM PERMISSIBLE
E. N. L'vovskaya and E. S. Kotova *In its* Med. Radiol. 11 Jan. 1965 p 1–7 refs (See N65-21208 11-04)

This report contains the results of dynamic observations conducted by ophthalmologists over a group of workers operating high-power accelerators—synchrocyclotron, accelerating protons, denitrons and alpha particles up to energies ranging from 480 to 840 MeV, and synchrophasotron. A number of examinees worked in conditions of prevagamma radiation not exceeding the permissible levels, while another group worked in conditions of possible n-irradiation. The results of ophthalmological investigations testify to the fact that 6- to 8-year long work under conditions of gamma-neutron radiation in doses approaching the maximally permissible ones does not cause any morbid changes in the organ of vision. Author

N65-21210 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DOSAGE CHARACTERISTICS AND PECULIARITIES OF BEING AFFECTED DURING EXPOSURE OF MICE TO γ-IRRADIATION OF A DOSAGE POWER OF 48 kg/min
L. B. Koznova *In its* Med. Radiol. 11 Jan. 1965 p 8–15 refs (See N65-21208 11-04)

The terminal portion of the dose curve for mice was studied during the use of Co^{60} gamma irradiation of a great dose intensity—48 kR/min. For the first time, by means of visual observation over animals during the process of irradiation, the data of the development of the disease with the life expectation following irradiation were confronted. Emphasis is on the great importance of individual peculiarities of the organism in conditions of the experiment, as action of radiation with a dose intensity of 48 kR/min in comparison with 0.387 to 2 kR/min, this fact broadening the notion on the range of dose intensities during which a reduction of the biological effect becomes manifest. Author

N65-21211 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HISTOCHEMICAL CHANGES IN LEUKOCYTES AT EXPERIMENTAL RADIATION ILLNESS
V. A. Almazov, T. L. Rogova, and E. A. Ruppe *In its* Med. Radiol. 11 Jan. 1965 p 16–24 refs (See N65-21208 11-04)

The morphological and cytochemical changes of granulocytopoiesis and leukocytes of the peripheral blood in rabbits with experimentally induced radiation sickness were assessed. It was found that in rabbits following irradiation along with cytopenia in the blood and hypoplasia in the bone marrow there occurs a considerable decrease of nucleic acid concentration, oxidation enzymes and glycogen. A diminished content of glycogen in neutrophils is usually preceded by its short-term rise (maximally 6 hours after irradiation). Changes of metabolic activity of neutrophils, along with their reduced content, are decisive factors in the development of septicemia in radiation sickness. Author

N65-21236# Joint Publications Research Service, Washington, D. C.
BIOLOGY AND ITS ALLIES
25 Mar. 1965 82 p ref Transl. into ENGLISH of the publ. "Biologiya i Yeye Soyuzniki" Moscow, "Znaniye" Publishing House, 1964 p 1–80
(JPRS-29292; TT-65-30591) CFSTI: $3.00

CONTENTS:

1. CONTEMPORARY BIOCHEMISTRY AND ITS IMMEDIATE TASKS N. M. Sisakyan p 2–17 refs

2. BIOCHEMISTRY OF RESPIRATION AND HEALTH S. Ye. Severin p 17–33

3. PHYSIOLOGY TOWARD NEW FRONTIERS V. V. Parin p 33–49

4. IN THE WORLD OF INAUDIBLE SOUNDS (ULTRASONICS IN BIOPHYSICS) I. Ye. El'piner p 50–69

5. THE PRESENT AND FUTURE OF RADIOBIOLOGY A. M. Kuzin p 69–79

N65-21237# Joint Publications Research Service, Washington, D. C.
CHANGES IN THE CONCENTRATION OF SEROTONIN IN THE BLOOD OF ANIMALS EXPOSED TO EFFECTS OF IONIZING RADIATION AND DYNAMIC FACTORS OF SPACE FLIGHT
V. V. Parin, V. V. Antipov, M. O. Raushenbakh, P. P. Saksonov, V. S. Shashkov et al 5 Apr. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), No. 1, Jan.–Feb. 1965 p 3–9 Presented at the 6th Intern. and 12th European Congr. of Aviation and Space Med., Rome, 1–5 Oct. 1963
(JPRS-29434; TT-65-30653) CFSTI: $1.00

In the animals studied (monkeys, dogs, guinea pigs, rats, and mice) two types of changes of the concentration of serotonine in the blood were observed during acute radiation sickness, after common γ-radiation of Co^{60}. In dogs, monkeys, and guinea pigs the disruption in the content of serotonin in the blood was of a sharply expressed nature and depended upon the seriousness of the radiation sickness, while in rats and mice the reduction in the concentration of serotonin was more weakly expressed and did not depend upon the seriousness of radiation damage. Author

N65-21241# Argonne National Lab., Ill.
HEALTH DIVISION GAMMA-RAY SPECTROSCOPY GROUP Semiannual Report, Jan.–Jun. 1964
Asher J. Finkel Jan. 1965 87 p refs
(Contract W-31-109-ENG-38)
(ANL-6839) CFSTI: $3.00

The results of several studies on human gamma-ray spectroscopy are discussed for *Long-Term Effects of Radium Deposition in Man*—current or terminal radium deposition in man; *Multiple-Crystal-Position Technique for Whole-Body Measurements*—procedure to reconstruct the gamma-ray profile along the long axis of the body without the use of a collimated crystal; *Distribution of Radium in Humans*—whole-body radiation measurements and skeletal X-rays for 280 patients, and detailed tables from measurements of 42 radium patients by the 7-crystal position technique; *Radium Retention in Mice after Single Intravenous Injection*—correspondence of the radium retention patterns of mice to that of man; *Some Problems of Accurate Measurement of Potassium in Man*—evaluation of the accuracy of three whole-body counting techniques; and Cs^{137} *Trends in Humans from 1955 to 1964*—variations of Cs^{137} in an individual reflect his dietary habits rather than the general fallout level. G.G.

N65-21309*# Republic Aviation Corp., Farmingdale, N. Y. Space Environment and Life Sciences Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, Oct. 1–Dec. 31, 1964
Lorraine S. Gall 7 Jan. 1965 25 p refs
(Contract NASw-738)
(NASA-CR-57812; RAC-931-6) CFSTI: HC $1.00/MF $0.50

Primary culturing and isolation of the predominating fecal flora of man in 20 subjects, and physiological studies on 27 FA-type cultures, including an additional type labeled FA-18, were conducted. Anaerobic growth was found to exceed the aerobic count by 1:1000 to 1:10 000 times. The number of times that strict anaerobes vs. facultative anaerobes occurred in the top three dilutions of the fecal material indicates that anaerobes are in the vast majority. To gain insight into the effects of man's intestinal bacteria on his nutrition, metabolic studies based on the fermentation of nitrogenous compounds which may be available for bacterial metabolism in the human digestive tract were made. FA-type cultures were tested for ability to produce indole as a byproduct of growth, for enzymatic decarboxylation of alpha amino acids to amines and carbon dioxide, and screened for the degree of deamination of casein hydrolyzate. Aerobic studies indicate that the vast majority of the gram negative rods isolated are *Escherichia coli*, many of which fall into various serotypes. L.S.

N65-21324*# Mayo Clinic, Rochester, Minn.
VIDEOROENTGENOGRAPHIC STUDY OF THE HEART AND LUNGS DURING EXPOSURE TO FORWARD ACCELERATION Semiannual Status Report
Earl H. Wood 1 Apr. 1965 23 p refs
(Grant NsG-327)
(NASA-CR-57958) CFSTI: HC $1.00/MF $0.50

A variety of roentgen videodensitometer studies of the heart and lungs during forward acceleration were made and the results are summarized. The only pathophysiologic effects of forward acceleration that pose a serious threat to the functional integrity of astronauts during the launch and reentry phases arise from the large hydrostatic pressure imbalances which develop in the lungs and thorax. It was concluded that the cardiopulmonary effects of acceleration carry the greatest likelihood of mission limiting or mission failure through the threat to the welfare of the astronaut. Appendixes contain the following studies: *Pleural Pressures in Dogs During Transverse Acceleration; Effect of Forward, Backward, Right Lateral and Left Lateral Acceleration on Blood Oxygen Saturation in Dogs;* and *Pericardial Pressures in Different Body Positions During Transverse Acceleration in Dogs Studied Without Thoracotomy.* G.G.

N65-21338*# Naval School of Aviation Medicine, Pensacola, Fla.
THE INNER EAR ANATOMY OF THE SQUIRREL MONKEY. THE STUDY OF HORIZONTAL SERIAL SECTIONS
Makoto Igarashi 16 Jul. 1964 90 p refs Joint report with NASA *Its* Monograph No. 8
(NASA Order R-93)
(NASA-CR-57931) CFSTI: HC $3.00/MF $0.75

This monograph includes a series of microphotographs of the horizontal serial sections under low magnification (about 20 x). This series is the right ear viewing from the superior. A branched arrow, which appears at the corner of each picture, indicates the plane parallel to the sagittal (occipito-frontal) line. The arrow is pointing toward the front, and the extension is toward the lateral. The interval between each picture is 200μ. Higher magnification views of some important structures from this series, from other animals, and from some humans are shown. Several bilateral temporal bone microphotographs (horizontal sections) of squirrel monkeys and cats are included. The modiolar angle and the posterior semicircular canal plane are clearly demonstrated. Author

N65-21363# Joint Publications Research Service, Washington, D. C.
NYSTAGMOGRAPHIC ANALYSIS OF THE FAST COMPONENT OF VESTIBULAR NYSTAGMUS CAUSED BY RADIAL ACCELERATION
M. M. Levashov 13 Apr. 1965 16 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 12, Dec. 1964 p 1424–1433
(JPRS-29571; TT-65-30728) CFSTI: $1.00

A detailed nystagmographic analysis of the slow and rapid movements of rabbit eyes during radial acceleration is discussed, with emphasis on the initial part of the reaction when the greatest changes in the ampullar apparatus are present. The animals were rotated in the horizontal plane and the nystagmus was recorded by direct photography of the eyes through a crack on a moving film. The rabbit's eyes were anesthetized with dicaine solution to prevent blinking. It was found that the velocity of the fast component of the vestibular nystagmus changes in the course of the reaction both in the direction of increase and decrease, with most pronounced changes observed at the beginning of rotational and postrotational nystagmus. The changes often fail to coincide with directional changes in velocity of the slow component. The vestibular nystagmus changes follow a pattern for 2000 milliseconds past rotation, and a relationship between the intensity of velocity and the vestibular apparatus is assumed. G.G.

N65-21390*# Republic Aviation Corp., Farmingdale, N. Y. Space Environment and Life Sciences Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, Jan. 1–Mar. 31, 1965
Lorraine S. Gall 31 Mar. 1965 24 p
(Contract NASw-738)
(NASA-CR-62108; RAC-931-7) CFSTI: HC $1.00/MF $0.50

Primary isolation of predominating fecal anaerobes in nine subjects was completed. Tables were prepared showing the distribution of the organisms, the distribution of the various types of cultures between the first and second groups of subjects, the types of cultures grouped according to frequency of occurrence, the aerobic plate count in millions, the height of the anaerobic plate count by tubes, and the number of times strict anaerobes vs. facultative anaerobes occurred. The ability of this type of culture to produce or use certain in vitamins was tested with respect to vitamin B_{12}, riboflavin, niacin, pantothenic acid, and folic acid. On the basis of other screening tests (glucose metabolism, decarboxylation, and deamination

activities), the organisms were classified into two main groups—carbohydrate fermentors and protein metabolizers. These data will be used in determining the function of each organism within the human body. L.S.

N65-21398# Mayo Clinic, Rochester, Minn.
USE OF DICHROMATIC EARPIECE DENSITOMETRY FOR DETERMINATION OF CARDIAC OUTPUT Final Report, 1 Oct. 1963–1 Nov. 1964
John H. Reed, Jr. and Earl H. Wood Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 18 p refs Presented to the Am. Physiol. Soc., Providence, 5 Sep. 1964
(Grants NsG-327; NIH-H-3532; Contract AF 33(657)-8899)
(AMRL-TR-64-134; AD-613335)

In situations which forbid direct arterial sampling such as space flight, estimation of cardiac output by ear densitometer may be justifiable. Compensation for changes in blood content and saturation recommend dichromatic densitometry. Simultaneous dilution curves following injection of 5 mg indocyanine green into the superior vena cava of nine healthy subjects and five patients during rest and exercise were recorded by a dichromatic ear densitometer, a conventional ear oximeter, and a cuvette coupled to the radial artery. The dichromatic earpiece densitometer showed a linear relationship between its calibration factor for dye and the relative blood content of the ear determined by inflating its pressure capsule to 250 mm of mercury. It is concluded that dichromatic earpiece densitometry may be useful in situations where more reliable methods are impossible. By use of a previously calibrated earpiece, it appears possible to obtain values for cardiac output without the necessity of withdrawal and spectrophotometric analysis of blood samples for calibration. Author

N65-21422*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
INVESTIGATION OF POTENTIAL ANTI-RADIATION AND ANTI-NEOPLASTIC COMPOUNDS RELATED TO PLANT GROWTH REGULATORS Second Quarterly Progress Report, 1 Oct. 1964–1 Jan. 1965
Robert D. Schultz and David Norman 1 Jan. 1965 19 p refs Sponsored by NASA
(Contract PH 43-64-865)
(NASA-CR-62133; SID-65-79-2) CFSTI: HC $1.00/MF $0.50

Investigations of cytotoxic effects of plant growth regulators on ascites tumors, in vitro, included (1) possible interference with an oncogenic virus–host cell interaction; (2) synergism or inhibition by indolyl compounds; (3) cytocidal activity of radiation-protective auxin analogs and related compounds; (4) morphological changes in carcinoma cells; and (5) effects of IABu(t) on the respiration of free Ehrlich ascites cells. Study of cytotoxic effects of plant auxin analogs on ascites tumors, in vivo, included the (1) effect of injection vehicle on tumorcidal activity; (2) acute cytocidal effects against P815 mast cell ascites tumor; and (3) in vivo experimentation. New data have also been derived on the radiation-protective effects of auxin analogs and in two-dimensional chromatography of indolyl compounds that are endogenous to some ascites tumors. E.E.B.

N65-21424*# Library of Congress, Washington, D. C. Space and Technology Div.
AEROSPACE MEDICINE AND BIOLOGY, AN ANNOTATED BIBLIOGRAPHY. VOLUME XI: 1962–1963 LITERATURE
Roman Kenk, ed. 1965 501 p refs Sponsored by NASA
(NASA-CR-62127) CFSTI: HC $5.00/MF $2.50

A selection of 2335 journal articles and other pertinent references are compiled in abstracted form. The bibliography is divided into the following sections: *General Aspects; Biology; General Physiology; Neuro and Sensory Physiology; Psychology and Psychiatry; Biological, Physiological, and Psychological Effects of Environmental Factors and Stresses; Personnel; Medical Problems and Pharmacology; Toxicology; Safety, Survival, and Rescue;* and *Man–Machine Integration and Life Support Systems.* Included are author, corporate, and subject indexes. G.G.

N65-21442# Atomic Energy Commission, Washington, D. C. Div. of Technical Information
RADIOACTIVE FALLOUT: A BIBLIOGRAPHY OF THE WORLD'S LITERATURE Supplement 2
William E. Bost and Hugh E. Voress, comp. Mar. 1965 267 p refs
(TID-3086, Suppl. 2) CFSTI: $6.00

Included are 1953 references to unclassified reports, journal articles, and other literature on the radioactive materials produced by nuclear explosions. The interactions of these materials with the biosphere and with its inhabiting organisms are the primary concern, but an attempt has also been made to cover contiguous areas. A subject arrangement of the references is employed, and author and report availability indexes are provided. This supplement covers the period from February 1962 through December 1963. Author

N65-21449# Pisa Univ. (Italy). Inst. of Physiology
COMPARATIVE NEUROPHYSIOLOGY OF VISION Final Report, 15 Sep. 1963–14 Sep. 1964
Giuseppe Moruzzi 15 Sep. 1964 16 p refs
(Grant AF-EOAR-63-9)
(AFOSR-65-0039; AD-455012)

The results are summarized for research on the following: (1) behavior of retinal units during dark adaptation; (2) study of biological noise in the retina; (3) transfer properties of the cat's eye; (4) effect of darkness on the onset of sleep in birds; (5) electroretinography in *Lycosa tarentula*; (6) intracellular recording from reticular neurons; and (7) relationships between midline thalamic nuclei and reticular formation. Author

N65-21473*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE EVOLUTION OF A SPACE FEEDING CONCEPT FOR PROJECT GEMINI
Robert A. Nanz, Edward L. Michel, and Paul A. Lachance [1964] 16 p refs Presented to the Inst. of Food Technologists, Washington, D.C., 24–28 May 1964
(NASA-TM-X-51697) CFSTI: HC $1.00/MF $0.50

The evolution of the feeding concepts used in Project Mercury missions, and envisioned for Project Gemini and early Apollo missions is described. Two distinct feeder and dispenser designs were developed almost simultaneously and then merged to provide the best of each. The evolution of the feeder design is illustrated. The principal changes were affected by whether or not the food was molded, and by water rehydration interface problems. An early concept used a solid plastic ring-type orifice, both as a water nozzle interface and as a feeding port. A similar early concept had a dual-purpose, but nonrigid, port. During the last Mercury flight, leakage at the feeder–water dispenser interface occurred during the in-flight evaluation and led to the present two-port concept. One port accepts the water probe for rehydration, and a separate port is provided at the opposite end for feeding. E.E.B.

N65-21477*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STUDIES ON THE LOCALIZATION AND MECHANISM OF ALKALINE METAL ACTIVATION OF PROTEIN SYNTHESIS

Henry A. Leon and Henry L. Speer [1964] 27 p refs Submitted for Publication

(NASA-TM-X-51788) CFSTI: HC $2.00/MF $0.50

The in vitro activation of rat liver protein-synthesizing systems by alkaline metals and ammonium ions occurs in a bimodal fashion with respect to the concentration. Detailed studies with K^+ show that the relative magnitudes of the two optima change when different energy regenerating systems are employed. The bimodal response of the incorporation process per se, which is the final expression of a multiple component dependency on K^+, for the most part involves steps concerned with the interaction between amino acyl S-RNA and the ribosomal complex. When this latter reaction is studied using microsomes, four to six individual peaks of K^+ stimulation are discernible. With *E. coli* ribosomes, multiple K^+ optima are seen for amino-acid incorporating systems which employ either native or synthetic messenger RNA. Indications are that these multiple optima are an expression of a ribosomal property which is altered by prior activity. The findings are discussed in the light of the presently expressed concepts concerning the structure of the functioning polysome. Author

N65-21478*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE ORIGIN OF LIFE IN THE UNIVERSE

Cyril Ponnamperuma [1964] 38 p Presented at the Space Sci. Education Conf., Los Angeles, 4 Jun. 1964 Submitted for Publication

(NASA-TM-X-51753) CFSTI: HC $2.00/MF $0.50

Classical and modern theories on the origin of the universe and of life are reviewed. Recent experiments and planned projected space experiments in exobiology and chemical evolution are discussed. E.P.V.

N65-21538# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology

X-IRRADIATION PROTECTION STUDIES. III: TOTAL DOSE AND RATE EFFECTS IN X-RAY PROTECTION STUDIES

James L. Leitch Mar. 1965 16 p refs

(Contract AT(04-1)-GEN-12)

(UCLA-12-547)

A new procedure for the evaluation of radiation protection studies based on mean cage survival time data is outlined. A drug combination of 10-μM AET plus 1-μM 5-HT administered i.p. 20 to 30 minutes prior to delivery of from 460- to 900-R whole-body X-irradiation affords protection if continuous exposure time does not exceed 45 to 60 minutes. This exposure time approximates the observed duration of this drug combination in mice. Author

N65-21540# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIOBIOLOGY (SELECTED CHAPTERS)

David Emmanvilovich Grozdenskiy 23 Jan. 1963 120 p ref Transl. into ENGLISH from the book "Radiobiologiya, Biologicheskoye Deystviye Ioniziruyushchikh Izlucheniy (Moscow), Gos. Izd. Lit. v Obl. At. Nauki i Tekhn., 1961 p 20–120

(FTD-TT-62-355/1+2+4; AD-295807)

Radiation effects on whole organisms, biological cells, and on the chemical constituents of cells are described. The radiation of water and of biogenous substances in vitro is discussed. Also included are the role of oxygen in irradiation, and radiation effects on cell structure, cell division, embryo, and fetus. The radiosensitivity of animals and plants, and radiation-induced metabolic disorders, cancer, and leukemia, are included. Chemical protection against radiation, and problems of treating radiation sickness are discussed. L.S.

N65-21570# Joint Publications Research Service, Washington, D. C.

THE USE OF FREE PHAGE AND THE SYSTEM PHAGE-BACTERIUM IN STUDYING THE PRIMARY BIOLOGICAL EFFECT OF IONIZING RADIATION

G. Ye. Fradkin 15 Apr. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, Jan.–Feb. 1965 p 44–52

(JPRS-29606; TT-65-30745) CFSTI: $1.00

Experimental analysis of comparative resistance to radiation of the genetic code programing and controlling systems of DNA of moderate phage lambda was investigated. The functional value of the programing apparatus was measured by the capacity of the radiated viral fragments to reproduce. The quantitative yield of virulent mutants from moderate phage lambda was incapable of completing the function of blockage of structural information. The quantity of virulent mutants was checked by contact of a radiated population of moderate phage with a lyzogenized culture of *E. coli* K-12 (lambda). For the appearance of virulent mutants of moderate viral particles, the increasing titer of phage (PHPh) was used as a peculiar biological reinforcement, revealing detectable mutation variations by a slight increase. Lyzogenized cells incapable of inducing prophage into phage with ionizing radiation were separated. Streptomycin-resistant variants of an indicator culture of *E. coli* and lyzogenized noninduced pure culture of *E. coli* K-12 was used to exclude the masking of end plates by extraneous microflora of the rise in phage titer with the methods of radiation genetics. It was concluded that the controlling apparatus of phage lambda DNA is more radiosensitive than the programing apparatus. R.W.H.

N65-21572# Joint Publications Research Service, Washington, D. C.

SETTING UP OF STANDARDS FOR MAXIMUM PERMISSIBLE CONCENTRATIONS OF INDUSTRIAL DUST

S. V. Miller 21 Apr. 1965 8 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), v. 9, no. 1, Jan. 1965 p 3–6

(JPRS-29693; TT-65-30790) CFSTI: $1.00

The problem of standardization of maximum permissible concentrations of industrial dust is reviewed. The present standard of 1 and 2 milligrams per cubic meter for strongly fibrogenic dust and 10 milligrams per cubic meter for dusts that are not very irritating is not questioned. However, the intermediate standard of 5 milligrams per cubic meter instead of a proposed 4, 6, and 8 milligrams per cubic meter is discussed in detail. Also the terms toxic, very toxic, nontoxic, and inert as applied to dust are considered. E.E.B.

N65-21573# Joint Publications Research Service, Washington, D. C.

CLINICAL SYNDROMES ARISING UNDER THE EFFECT OF VARIOUS RADIO FREQUENCY BANDS

E. A. Drogichina and M. N. Sadchikova 21 Apr. 1965 10 p Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniye (Moscow), v. 9, no. 1, Jan. 1965 p 17–21

(JPRS-29694; TT-65-30791) CFSTI: $1.00

The development of various stages of the diseased state produced by the action of radiofrequencies, and the differentiation between individual syndromes were investigated. The asthenic syndrome apparently develops because of the exhausting action of the radio waves on the higher divisions of the central nervous system. Observed are an increase in fatigue, headaches, sleepiness during work, an inclination toward bradycardia and arterial hypotonia, and weak pronounced symptoms of vegetative hyporeactivity. Clinical observations detected neurotic reactions and asthenization phenomena of the cerebrasthenia type. A number of patients exhibited a trophic disturbance and a decrease in sexual potency. The asthenovegetative syndrome which characterizes the second stage of the pathological condition regresses slowly and may lead to a temporary decrease in working capacity. An objective investigation disclosed trembling of the fingers of extended hands, stimulation of tendon reflexes, a pronounced dermography, hyperhydrosis, and a decrease in sensitivity to pain (the threshold according to the algesimeter was 0.5 mm). Examination of the blood showed a tendency toward leukopenia (from 3600 to 4900 leukocytes). R.W.H.

N65-21724*# Naval School of Aviation Medicine, Pensacola, Fla.

RADIATION EXPOSURE IN SOLAR PARTICLE BEAMS BEHIND VERY LOW SHIELDING

Hermann J. Schaefer 19 Feb. 1965 14 p refs Joint report with NASA

(NASA Order R-75)

(NASA-CR-62198; NSAM-914) CFSTI: HC $1.00/MF $0.50

Outside the vehicle the astronaut is protected from radiation merely by his space suit with a shielding equivalent of about 0.1 g/cm^2. Evaluations based on a spectral model for a solar particle beam suggested by Weir and Brown show that the skin dose for such low shielding is due predominantly to the alpha component of the flare beam. Sixty-five percent of this alpha skin dose is produced at a high LET corresponding to a QF of 6 and an RBE of 3. The alpha dose itself, as well as QF and RBE, drops much more steeply with increasing depth in tissue than the proton dose. Analysis of the thickness distribution of a space suit due to the structural inhomogeneities shows that substituting the mean for the actual distribution introduces an error of only 2% in the surface tissue dose behind the suit materials. The findings indicate that a correct assessment of exposure in solar particle beams behind low shielding requires LET sensors in addition to instrumentation for measuring total rad doses. Author

N65-21725*# National Aeronautics and Space Administration, Washington, D. C.

ESSAY ON THE HISTORY OF AVIATION MEDICINE

A. A. Sergeyev Apr. 1965 421 p refs Transl. into ENGLISH of the publ. "Ocherki po Istorii Aviatsionnoy Meditsiny" Moscow, USSR Acad. of Sci. Publishing House, 1962

(NASA-TT-F-176) CFSTI: HC $7.25/MF $2.25

CONTENTS:

1. BEFORE THE DEVELOPMENT OF AVIATION MEDICINE p 1–25 refs (See N65-21726 11-04)

2. THE DEVELOPMENT OF AVIATION MEDICINE—THE FIRST PERIOD p 26–40 refs (See N65-21727 11-04)

3. AVIATION MEDICINE OUTSIDE RUSSIA DURING AND IMMEDIATELY AFTER THE FIRST WORLD WAR (1914–1920) p 41–54 refs (See N65-21728 11-04)

4. ORIGINS OF SOVIET AVIATION MEDICINE p 55–61 refs (See N65-21729 11-04)

5. EMERGENCE OF SOVIET MEDICINE p 62–75 (See N65-21730 11-04)

6. AVIATION MEDICINE OUTSIDE RUSSIA 1920–1930 p 76–92 refs (See N65-21731 11-04)

7. THE GOLDEN AGE OF SOVIET AVIATION MEDICINE 1930–1940 p 93–112 (See N65-21732 11-04)

8. PHYSIOLOGIC CONDITIONS FOR STRATOSPHERE BALLOON FLIGHTS p 113–127

9. THE CENTRAL SCIENTIFIC PSYCHOPHYSIOLOGICAL LABORATORY FOR THE STUDY OF CIVIL AIRCREW EFFICIENCY p 127–139 refs

10. THE INSTITUTE OF AVIATION MEDICINE p 139–158 refs

11. THE KIROV MILITARY MEDICAL ACADEMY p 159–196 refs

12. THE ALL-UNION INSTITUTE OF EXPERIMENTAL MEDICINE (AIEM) p 196–205 refs

13. CONTRIBUTION OF SOVIET MOUNTAINEERING PHYSIOLOGISTS TO AVIATION MEDICINE p 206–224 refs (See N65-21733 11-04)

14. AVIATION MEDICINE IN THE USSR DURING THE SECOND WORLD WAR p 225–253 refs (See N65-21734 11-04)

15. A BIBLIOGRAPHY OF WORKS IN RUSSIAN ON AVIATION MEDICINE UP TO 1950 p 254–398 refs (See N65-21735 11-04)

N65-21726* National Aeronautics and Space Administration, Washington, D. C.

BEFORE THE DEVELOPMENT OF AVIATION MEDICINE

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 1–25 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

An historical review of studies by Russian scientists on mountain sickness, and the consumption of rarefied air and its effect on the respiratory and circulatory systems of the human organism is presented. These research investigations have contributed immensely to Russian aviation medicine. R.W.H.

N65-21727* National Aeronautics and Space Administration, Washington, D. C.

THE DEVELOPMENT OF AVIATION MEDICINE—THE FIRST PERIOD

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 26–40 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Historically, aviation medicine began to develop in Russia in 1910. In Russia and France, publications, regulations, and instructions were printed before the First World War or the selection, physiology and hygiene of aviators. The foundations of Russian aviation medicine were established when the flying club (All-Russian Flying Club, organized on 25 October 1908) passed its resolution on the medical examination of pilots in 1909. A resolution on the supply of instruments and apparatus for studying the effect of flights on the human organism was sent to the officers' flying school and delegated the preparation of a list of equipment to the commission that had compiled the list of diseases and physical defects that debarred individuals from entering aviation units. During the First World War there was a decline of aviation medicine in Russia and only three works appeared dealing with ballooning and not aviation. The revival did not come until the first 10 years after the resolution. Exceptional development occurred in the 1930's. R.W.H.

N65-21728* National Aeronautics and Space Administration, Washington, D. C.

AVIATION MEDICINE OUTSIDE RUSSIA DURING AND IMMEDIATELY AFTER THE FIRST WORLD WAR (1914–1920)

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 41–54 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Progress made outside of Russia in aviation medicine during and after the First World War is discussed. The development of aviation medicine was directly related to progress in aviation technology, which aroused public opinion and drew the attention of doctors to the new problems. Despite the attempts of individual medical enthusiasts to devote their energies to the study of the occupational features of flying, French aviation medicine was in a poor state at the beginning of the First World War. The physiological trend in French aviation medicine promoted a number of articles devoted to circulatory reactions. Seven orthocardiographic studies were published demonstrating that enlargement of the heart was bound to occur in pilots who ascended to high altitudes without oxygen. Main trends in aviation medicine (psychophysiological, clinical, and physiological) were outlined and consolidated in France at the end of the First World War. Italy, Germany, and the United States also made contributions to aviation medicine around the time of the First World War. R.W.H.

N65-21729* National Aeronautics and Space Administration, Washington, D. C.

ORIGINS OF SOVIET AVIATION MEDICINE

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 55–61 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

During the First World War the doctors attached to Soviet aviation units did not conduct any research and there was no report of their investigations. Because the blockade and the Civil War made foreign literature unavailable to Russian doctors, the first Soviet aviation doctor, S. E. Mints, came forward unrecognized. Mints collected literature on aviation medicine, particularly German literature of the latter years of the war. In the initial stages of its development Soviet aviation medicine adopted an incorrect approach to the solution of the difficult questions of selection. In adopting the tests current in bourgeois psychology without any criticism and in relying on purely arithmetical calculations of errors and mistakes by the person being tested, Soviet aviation medicine fell into a psychotechnical approach from which it did not escape until the late 1920's. Although Mints' work was confined to introducing foreign methods and supporting psychotechnical research, he was the first Soviet aviation doctor to indicate the need for medical study of the work and conditions of pilots. R.W.H.

N65-21730* National Aeronautics and Space Administration, Washington, D. C.

EMERGENCE OF SOVIET AVIATION MEDICINE

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 62–75 (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

During the period of the 1920's to the 1930's the distinguishing feature was the gradual freeing of aviation medicine from foreign influences, the formulation of theoretical principles, the wide development of research in the Central Psychophysiological Laboratory and in outlying units, and the selection of qualified doctors for aviation medicine. During the emergence period three trends emerged: (1) a psychophysiological trend—replacing the former psychotechnical trend, with little difference; (2) a physiological trend—confined to the effect of altitude; and (3) a clinical trend—this led to a well-thought-out system of medical selection for pilots. R.W.H.

N65-21731* National Aeronautics and Space Administration, Washington, D. C.

AVIATION MEDICINE OUTSIDE RUSSIA, 1920–1930

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 76–92 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Development of aviation medicine in numerous countries (excluding Russia) during the decade 1920 to 1930 is described. Papers presented at five international congresses on aerial communications are discussed. The papers concerned various effects of flight on pilot's health, medical qualifications for flight training, and physiological aspects of operating an airplane. The concept of the ambulance airplane, which was developed during these years, is presented. Aviation medicine research is described in Europe generally, and separately for the United Kingdom, France, Germany, Italy, and the United States. Brief mention is made of activities in Poland, Denmark, Sweden, Australia, Thailand, and Switzerland. J.M.D.

N65-21732* National Aeronautics and Space Administration, Washington, D. C.

THE GOLDEN AGE OF SOVIET AVIATION MEDICINE, 1930–1940

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 93–112 (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Development of research in aviation medicine in Russia during the decade 1930 to 1940 is described. The founding and organizing of two psychophysiology laboratories is reviewed, and the work of a number of their staff members is discussed; their work concerned design and use of a centrifuge in studying the effects of acceleration on living organisms, the physiology of high flight and night flight, function of the vestibular apparatus, human response to reduced atmospheric pressure in a pressure chamber, and lighting and color illumination of the pilot's cabin. Flights by Russian aviators, said to have established various records, are listed. J.M.D.

N65-21733* National Aeronautics and Space Administration, Washington, D. C.

CONTRIBUTION OF SOVIET MOUNTAINEERING PHYSIOLOGISTS TO AVIATION MEDICINE

In its Essay on the History of Aviation Med. Apr. 1965 p 206–224 (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Mountain ascents by Russian physiologists during the decade 1930 to 1940, and their studies of high-altitude effects on living organisms, are described. Results of these experiments on both men and dogs were applicable to problems in aviation physiology. The topics of investigation included acclimatization and adaptation of the human organism to reduced atmospheric pressure, anoxia, acid-alkali balance, polyglobulia, olefactory function, salivation, respiration, blood circulation, and chronaximetry studies of skin sensitivity, vestibular apparatus, and excitability of the visual apparatus. J.M.D.

N65-21734* National Aeronautics and Space Administration, Washington, D.C.

AVIATION MEDICINE IN THE USSR DURING THE SECOND WORLD WAR

In its Essay on the Hist. of Aviation Med. Apr. 1965 p 225–253 (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

Reorganization of various Russian aviation medicine research institutes during the Second World War, and the wartime aviation research activities of numerous Russian physiologists and flight doctors, are reviewed. Much of the work of qualified aviation medicine personnel was directed toward problems of the war effort, such as evacuation and treatment of aircrew casualties and training of flight doctors. Aviation research accomplished during this period concerned the etiology of decompression sickness, adaptation of the central nervous system to high altitudes, gas exchange and tissue

respiration following hypoxemia, metabolism under high-mountain conditions, effects of acceleration on fliers, comfortable altitudes for passengers during long flight, and prevention of hypoxemia. J.M.D.

N65-21735* National Aeronautics and Space Administration, Washington, D. C.
A BIBLIOGRAPHY OF WORKS IN RUSSIAN ON AVIATION MEDICINE UP TO 1950
In its Essay on the Hist. of Aviation Med. Apr. 1965 p 254–398 refs (See N65-21725 11-04) CFSTI: HC $7.25/MF $2.25

A bibliography of approximately seventeen hundred Russian publications on aviation medicine is given. Titles are listed in alphabetical order of senior author's last name, and sources are given. J.M.D.

N65-21738*# Texas Inst. for Rehabilitation and Research, Houston.
THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART XIV: EFFECT OF BEDREST ON PLASMA LEVELS AND URINARY EXCRETION OF 17-HYDROXYCORTICOSTEROIDS
D. Cardus, C. Vallbona, F. B. Vogt, W. A. Spencer, H. S. Lipscomb et al Washington, NASA, Apr. 1965 17 p refs
(Contract NAS9-1461)
(NASA-CR-184) CFSTI: HC $1.00/MF $0.50

Plasma levels of 17-hydroxycorticosteroids at 0800, 1200, 1600, 2000 and 2400 hours were determined on six healthy subjects who were submitted to bedrest for 3 days. The determinations were made with a modification of the Peterson method and the Porter–Silber technique. During bedrest the peak level at 0800 seemed a little lower than normal, but the circadian rhythm of 17-hydroxycorticosteroids was not modified. During bedrest and isometric exercises, the rhythm and the levels of 17-hydroxycorticosteroids were normal. Relatively short periods of physical inactivity seem to have no effect on the circadian rhythm of 17-hydroxycorticosteroids. Author

N65-21804# Joint Publications Research Service, Washington, D. C.
RADIATION BARRIER AND MAN IN SPACE
Yu. Volynkin, P. Saksonov, and N. Dobrov 19 Apr. 1965 9 p Transl. into ENGLISH from Izv. (Moscow), 21 Mar. 1965 p 2
(JPRS-29656; TT-65-30768) CFSTI: $1.00

CONTENTS:

1. MAN IN SPACE p 1–4
2. THE RADIATION BARRIER Yu. Volynkin and N. Dobrav p 5–7

N65-21823# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology
CHEMICAL PROTECTION IN HEALTH PHYSICS
James L. Leitch Apr. 1965 20 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-551)

The compounds that have been reported as having protective action against the lethal effects of ionizing radiation are reviewed. A more extensive discussion is given on experimental work using AET (2-aminoethylisothiouronium bromide hydrobromide) and 5-HT (5-hydroxytryptamine creatinine sulfate = serotonin) and of the variations in its protective action as influenced by the total dose of X- or γ-radiation, the dose rate, and the dose of drugs administered. Particular emphasis is placed on the possible applications of protective chemicals to health physics problems. Author

N65-21824# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology
COMPARISON OF PROTECTION AGAINST X- AND GAMMA RADIATION BY AET PLUS 5-HT
James L. Leitch Apr. 1965 15 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-552)

The DAL-Swiss female mice were irradiated either with 250-kVp X-rays at 15 mA (HVL = 2.3-mm Cu) or with gamma rays from a 10000 curie Co^{60} source. In any one experiment, half the mice were given, intraperitoneally, 10 μM AET (2-aminoethylisothiouronium bromide hydrobromide) plus 1 μM 5-HT (5-hydroxytryptamine creatinine sulfate). Protection is evaluated on the basis of the percent increase in mean survival time of pretreated mice compared with that of mice not pretreated prior to irradiation. When the above drug combination was administered 5 to 10 min prior to the start of a 1200-R dose of whole-body X-irradiation delivered at 80 R/min, protection was observed. Animals similarly pretreated but irradiated with Co^{60} gamma rays (total dose = 1200 R at 80/min) show an increased mean survival time greater than that of animals exposed to X-rays. A differential effect of the two types of radiation on the catabolism of the drugs is suggested. Author

N65-21854# Texas Christian Univ., Fort Worth. Inst. of Behavioral Research
DIMENSIONS OF STIMULUS SITUATIONS WHICH ACCOUNT FOR BEHAVIOR VARIANCE Quarterly Status Report
S. B. Sells 1 Jul. 1964 6 p refs
(Contract Nonr-3436(00))
(AD-602369)

An investigation based on quantitative measurement, dimensional description, and eventual taxonomic analysis of physical and social environmental variables influencing individual behavior is presented. Data was collected from various cross-sections of the student body at Texas Christian University. Reported are results from a taxonomic analysis, an analysis of group dimensions of campus organization, and studies of the meteorological effects on day-to-day fluctuation in anxiety level. A general review of the literature concerned with the detailed documentation of environmental variables is also presented. S.C.W.

N65-21879# Indiana Univ., Bloomington. Dept. of Anatomy and Physiology
THE GASEOUS ENVIRONMENT AND TEMPERATURE REGULATION Annual Progress Report, Mar. 1, 1963–Sep. 1, 1964
Robert W. Bullard [1964] 31 p refs
(Contract DA-49-0070-MD-947)
(AD-446902)

A neural rather than a thermal mechanism is suggested for a rapid sweating rate response to heavy physical exertion in a warm environment. The possibility that the response is moderated through the firing of thermal receptors either in the working muscles themselves or in contact with the venous drainage of these muscles is considered. A similar sweating response was seen in a cool room (30° to 23° C) only in skin areas locally heated or treated with pilocarpine, indicating that the temperature and activity state of sweat glands can have

considerable influence on their function. Sweating in the recovery period immediately following CO_2 respiration is greatly depressed, along with skin and deep body temperature. However, sweating then returns to a normal rate with lower deep body temperatures, but with higher skin temperatures at the same ambient temperature. Intracranial temperature measurements by the use of self-repetitive ultrasonic instrumentation are being tried. An instrument is being built with greater stability at the required resolution. Reprints of the published studies are appended. L.S.

N65-21897# Institute for Behavioral Research, Inc., College Park, Md.
EXPERIMENTS IN HUMAN COLOR VISION Annual Progress Report, Aug. 1–Dec. 31, 1964
John Krauskopf 31 Dec. 1964 9 p refs
(Contract DA-49-193-MD-2669)
(AD-455490)

Work on three projects is reported: (1) Vision during saccadic eye movements—experiments reported tested the classical theory that vision is inhibited during involuntary saccadic eye movements. Absolute thresholds and vernier acuity thresholds were measured either during saccades or at some fixed time following saccades. If inhibition occurs thresholds should be elevated during saccades. No such effect was found. The confidence limits of the thresholds precluded existence of any meaningful difference in thresholds. (2) Effect of small monochromatic stimuli—significance of previous experiments is reviewed; it is concluded possible to achieve conditions under which only one color receptive field is stimulated. (3) Behavioral measurement of spectral sensitivity in turtle—turtles were trained to discriminate steady, as opposed to flickering, lights; experiments with white lights show that the discrimination breaks down as the brightness of the two components is approximately equated. Experiments with colored lights indicated the need for an apparatus providing more intense stimuli. Author

N65-21933# California Univ., Livermore. Lawrence Radiation Lab.
EFFECTIVE HALF-LIFE OF FALLOUT RADIONUCLIDES ON PLANTS WITH SPECIAL EMPHASIS ON IODINE-131
Stanley E. Thompson 29 Jan. 1965 19 p refs
(Contract W-7405-ENG-48)
(UCRL-12388) CFSTI: $1.00

The discrepancy between the observed mean reduction times for fallout radioisotopes deposited on plants and the radioactive half-lives of the nuclides is due to a number of variables. The same variables operate regardless of isotope involved, and are related to the behavior of particles on plants. Physical and biological factors modify this behavior, accounting for the differences noted. The most probable effective half-life of any radioisotope on plants can be calculated by

$$T_3 = \frac{13T_2}{13 + T_2}$$

where T_3 = effective half-life, and T_2 = radiological half-life. Author

N65-22061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PERFECTION OF INTEROCEPTIVE ANALYSIS DURING ACUTE HYPOXEMIA AND HYPERCAPNIA IN MAN
A. B. Gandel'sman and N. B. Prokopovich 20 Feb. 1963 13 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 12, no. 2, 1962 p 223–228
(FTD-TT-62-1903/1+2+4; AD-298655)

The physiological mechanism of interoceptive analysis developed during athletic training was studied by a comparison of the objective dynamics of acute hypoxemia and hypercapnia with the data of self-evaluation of the test subjects concerning the degree of sensation of increasing dyspnea. A total of 300 experiments were carried out by placing 17 athletes in a closed space and recording the oxygen saturation level of their blood by an oxyhemograph. Hypercapnia was judged by the percentage of CO_2 in the final air of the closed space. Results showed that highly trained athletes achieved high accuracy in evaluating the changes in the oxygen saturation level of their blood after only one or two experiments, and that the accuracy of self-evaluation was considerably lower in untrained men. The main source for the interoceptive sensation seems to be the stimulation of the chemoreceptors of the vessel walls upon increase of the stimulus force by hypoxemic and hypercapnic shifts. Development of acuity of vascular feeling facilitates the distribution of physical loads in time. Improvement of the interoceptive analysis by teaching without motor training is possible. G.G.

N65-22067# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN EXPERIMENTAL OBSERVATIONS OF THE EFFECT OF A HIGH FREQUENCY ELECTROMAGNETIC FIELD IN VIVE AND IN VITRO
K. Marha 18 Mar. 1965 11 p refs Transl. into ENGLISH from Pracovni Lekar. (Prague), v. 15, no. 6, 1963 p 238–242
(FTD-TT-64-898/1+2; AD-460316)

A series of high frequency experiments on male rats in a frequency band of 12, 10, 6, and 3 cm found the functional density more than lethal. The typical rat behavior started with an effort to escape, followed by paralysis of the extremities, convulsions, and ended in death. Interruption of the experiments before the convulsions started resulted in a 100% regeneration. Exposure of the animals for several times in 3-minute intervals to a field of the same density, or preexposure to a 100 times smaller dosage had a cumulative effect on the cm wave potential. Pulsed HF operation was biological by more effective than cw operation. Experiments in vitro at the same operational density and an exposure time up to 120 min established thermal denaturation changes in human serum albumin. It was concluded that the harmful effect of an HF field cannot be explained by the heating of the organism. There is a possibility that small dosages of Hf may cause genetic changes. G.G.

N65-22069# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WHEN DOES RADIATION RECEDE?
P. Sazonov 11 Feb. 1965 10 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), no. 10, 12 Jan. 1964 p 6
(FTD-TT-64-948/1; AD-611548)

The possibility of protecting human beings against ionizing radiation with the aid of chemical substances is discussed. The effectiveness and the toxicity of several known radioprotective agents is described. TAB

N65-22075# Presbyterian-St. Luke's Hospital, Chicago, Ill. Div. of Pathology
AN EVALUATION OF STEROID ANTIHISTAMINIC THERAPY IN EXPERIMENTAL CEREBRAL EDEMA

Raymond A. Clasen, Pauline M. Cooke, Sylvia Pandolfi, George Carnecki, and George M. Hass Brooks AFB, Tex., AF School of Aerospace Med., Dec. 1964 20 p refs
(Contract AF 41(609)-1908)
(SAM-TDR-64-56; AD-458897)

Focal areas of hemorrhagic necrosis were produced in the brains of anesthetized monkeys. The animals were followed for a period of 12 hours, after which they were sacrificed and the cerebral hemispheres were analyzed chemically for their electrolyte and water content. A second group of animals was treated with a combination of prednisolone and chlorprophenpyridamine maleate given 1 hour after injury. No evidence that this form of treatment reduced the edema associated with these lesions was obtained. Author

N65-22076# School of Aerospace Medicine, Brooks AFB, Tex. Aeromedical Indoctrination Dept.
INDUCTION OF RESISTANCE TO MOTION SICKNESS THROUGH REPEATED EXPOSURE TO CORIOLIS STIMULATION
Patrick J. Dowd Dec. 1964 14 p refs
(SAM-TR-64-87; AD-460110)

This report presents information of a method of repeated self-induced Coriolis stimulation, using four conditions: chair tilt, head movements in the lateral plane, head movements in both lateral and frontal planes, and head movements only in the frontal plane, on the SAM biaxial stimulator. The subject was evaluated for vestibular sensitivity after several incidents of motion sickness during flight training on the T-37 aircraft. Final testing after completion of this programed self-induced Coriolis stimulation indicated a resistance to motion sickness as determined from general autonomic reactions and data analysis of electronystagmograms. The subject has completed his solo-flight training on the T-37 aircraft without any report of motion sickness. Author

N65-22081# Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology
RADIATION PASTEURIZATION OF SHRIMP AND OYSTERS Final Summary Report, Jan.–Dec. 1964
Arthur F. Novak and Joseph A. Liuzzo Washington, AEC, 15 Jan. 1965 30 p refs
(Contract AT(40-1)-2951)
(ORO-626) CFSTI: $2.00

The preservation of shrimp and oysters by radiation pasteurization using cobalt 60 was studied. Field trials on public acceptance of radiation pasteurized shrimp and oysters were successful according to results obtained from organoleptic, chemical, and bacteriological tests of the products. Low level radiation extended the storage life of shrimp from 7 to 14 days and of oysters from 5 to 10 days. Physiological studies of radiation-resistant bacteria in shrimp suggested alterations in the metabolic roles of NAD, Coenzyme A and thiamine pyrophosphate, induced by low dose radiation. An investigation of radiation induced changes in the kinetics of shrimp enzymes showed that radiolysis products formed during the low dose gamma irradiation were responsible for the inactivation of phenolase and the subsequent reduction of melanosis. The use of liquid nitrogen for storage of shrimp prior to irradiation resulted in shrimp superior to the ice stored controls. Bacteriological studies with irradiated oysters showed a reduction in count of 95%. The physiology of radiation resistant bacteria in oysters was investigated in respect to the influence of irradiation in the normal metabolic patterns of these bacteria. Chemical analysis of oysters for pH, glycogen, ammonia nitrogen, trimethylamine nitrogen, and indole showed no significant differences between the irradiated and nonirradiated samples. Analysis of thiamine, riboflavin, niacin, and pantothenic acid in oysters showed that thiamine and niacin concentrations were reduced by irradiation, whereas riboflavin and pantothenic acid increased. S.C.W.

N65-22094# Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.
STUDY OF IRRADIATED-PASTEURIZED FISHERY PRODUCTS
Joseph W. Slavin and Louis J. Ronsivalli Washington, AEC 30 Nov. 1964 59 p refs
(Contract AT(49-11)-1889)
(TID-21600) CFSTI: $3.00

Research results on radiopasteurization of fish and fish products are reported. Optimum dose and acceptance levels for irradiated pollock, ocean perch, cod, and mackerel fillets were established, and the effect of preirradiation quality on postirradiation shelf life of cod fillets was determined. The suitability of plastic materials for packaging irradiated products, changes that occur in flavor and odor as a result of irradiation and storage, and bacterial quality of irradiated samples are also discussed. Results are considered in light of their importance to food technology. S.C.W.

N65-22098# Atomic Energy Commission, Washington, D. C. Div. of Technical Information
BIOLOGICAL APPLICATIONS OF GAMMA RADIATION
Helen L. Ward, comp. Jan. 1965 99 p refs
(TID-3580) CFSTI: $3.00

This bibliography contains 962 selected references on the uses of gamma radiation in all fields of biological and medical research. The major reference sources were: *Nuclear Science Abstracts, The Bibliography of Agriculture, Biological Abstracts, Chemical Abstracts, Index Medicus,* and *International Abstracts of Biological Sciences.* The period covered was 1958 through 1963. Author and report number availability indexes are included. Author

N65-22112# Joint Publications Research Service, Washington, D. C.
INTRAOCULAR TENSION AND BLOOD PRESSURE
T. A. Aleksidze 26 Apr. 1965 17 p Transl. into ENGLISH from the book "Nekotoryye Voprosy Regulyatsii Vnutriglaznogo Davleniya" Tbilisi, 1964 p 12–26, 134–136
(JPRS-29756; TT-65-30819)

Results of an investigation on the relationship between systemic blood pressure and intraocular pressure as influenced by age, systemic diseases, systemic blood pressure, reserpine, and daily pressure fluctuations, are reported. An extensive survey of the literature which indicates that increased inflow of blood in the eye raises lateral pressure in intraocular vessels thus increasing intraocular pressure, is included in the report. S.C.W.

N65-22113# Joint Publications Research Service, Washington, D. C.
ORIENTATION AND NAVIGATION OF ANIMALS: THE MOST IMPORTANT TRENDS IN RESEARCH IN BIONICS
B. P. Manteyfel, N. P. Naumov, and V. Ya. Yakobi 26 Apr. 1965 16 p Transl. into ENGLISH from Priroda (Moscow), no. 2, 1965 p 26–32
(JPRS-29757; TT-65-30820) CFSTI: $1.00

Results of bionomical investigations on the mechanisms of orientation and navigation used by animals under natural, variable environmental conditions are reported. The role of

the receptors in supplying basic faculties for animal orientation such as perception of various signals from the external world, active location, emission of signals, and the reception of their reflections is discussed. Orientation behavior was studied in fish, amphibia, mammals, birds, reptiles, cetaceans, bats, dolphins, and insects. Long distance orientation and navigation were studied in respect to animal migration. It was found that migrations and their direction constituted an inalienable biological property of a given animal species in definite sections of its territory. Investigations on the migratory behavior of fish and birds supported the premise that these animals possessed navigational abilities which enabled them to accurately determine their direction and reach designated geographic points by using more than one route. The importance of bionomical investigations on long distance orientation to technical advancement, and important problems in the field of navigation and orientation are also discussed. S.C.W.

N65-22115# Joint Publications Research Service, Washington, D. C.

USE OF ELECTRONIC COMPUTERS FOR SUBSTANTIATION OF DIAGNOSIS

K. Khidoyatov 28 Apr. 1965 34 p Transl. into ENGLISH Vopr. Vychislitel'noy Mat. i Tekhn. (Tashkent), no. 1, 1964 p 144–179

(JPRS-29799; TT-65-30840) CFSTI: $2.00

The use of the Ural-1 computer for the establishment of diagnosis and treatment of disease is reported. The order of preparation of data in respect to disease complexes, symptom complexes, unconditioned probability of disease complexes, and the order of computer calculation for single and multiple disease complexes are described. Sample problems are included. S.C.W.

N65-22116# Joint Publications Research Service, Washington, D. C.

BIOMEDICAL ASPECTS OF MAN'S FIRST EMERGENCE INTO OUTER SPACE

V. Parin 28 Apr. 1965 7 p Transl. into ENGLISH from Pravda (Moscow), no. 79 (17031), 20 Mar. 1965 p 3

(JPRS-29800; TT-65-30841) CFSTI: $1.00

The special coordination of movements and the ability to orient oneself and move about purposefully under weightless conditions are discussed. The analyzer systems function differently in weightlessness and there is a decrease in the flow of nerve impulses from the sensory elements in muscles and skin. This causes a change in the information connections established in the central nervous system. Unusual impulses from the receptors of the vestibular apparatus create additional difficulties for the mechanisms that regulate the activity of the various organs and systems. The special measures taken to ensure the cosmonaut's safety when he stepped into space are considered. Also, the dangers from meteorites and cosmic radiation are discussed. Further, the role of space medicine in interplanetary flight is included. E.E.B.

N65-22121# Joint Publications Research Service, Washington, D. C.

AN EXPERIMENTAL STUDY OF POLYDISPERSED BACTERIAL AEROSOLS

V. P. Zhalko-Titarenko 30 Apr. 1965 10 p Transl. into ENGLISH from Zh. Mikrobiol. Epidemiol. i Immunobiol. (Moscow), no. 2, 1965 p 68–73

(JPRS-29840; TT-65-30863) CFSTI: $1.00

Viability of the diphtheria bacillus in aerobic media was studied experimentally. To approximate the natural environment of the bacillus, an experiment on the diffusion of a suspension of bacilli in saliva was conducted at 35° C; for comparison, aerosols consisting only of cells of washed bacteria were studied. Graphs for the saliva and water-base experiments show viability as a function of time (up to 120 minutes). In another series of tests, viability in a polydispersed aerosol was investigated at 35°, at about 20°, and below 0° C; the resulting viability graph is shown. It was noted that a delay in saliva evaporation and the prevalence of large particles—conditions which represent the natural state of saliva—favored viability; however, viability was better at temperatures below zero than at 35° C. J.M.D.

N65-22131*# Hawaii Univ., Honolulu.

BODY FLUID VOLUME AND ELECTROLYTE DERANGEMENTS IN FASTING Semiannual Report No. 1, Dec. 1, 1964–Mar. 31, 1965

Terence A. Rogers, Bryant T. Sather, and Myrtle L. Brown Apr. 1965 7 p

(Grant NGR-12-001-010)

(NASA-CR-62298) CFSTI: HC $1.00/MF $0.50

Results are reported of electrolyte balance studies on rats designed to determine whether rats, like man, continue to lose urinary sodium at the onset of a fast and whether this is exacerbated by fasting in the cold. Rats were fed a standard diet containing 20.26-mEq sodium per 100 grams before and after fasting. Sodium balance (sodium intake minus urine sodium) was measured in fasting rats kept at 26° and 3° C. Control animals showed a slightly increased positive balance in cold temperatures. Negative sodium balance in rats fasting at 3° was greater and subsequent retention of sodium upon refeeding was more marked than in those fasting at 26° C. A substantial magnesium excretion by fed and fasted rats exposed to cold temperatures, and a sudden fall of urinary magnesium excretion upon return to warmer temperatures were attributed to a primary response to cold as opposed to a reflection of increased gluconeogenesis. Further investigations were made to determine whether the sodium balance status of rats prior to fasting or cold exposure would affect subsequent sodium losses. Rats fed a sodium deficient diet for 3 days prior to fasting and/or exposure to 3° C did not show a significant negative sodium balance. Weight loss during fasting was lower in rats previously fed sodium deficient diets than in those fed normal diets. Sodium depleted rats showed an even more marked negative magnesium balance than those on a normal diet. Magnesium excretion was terminated abruptly on return to 26° C. S.C.W.

N65-22165*# California Univ., Los Angeles. Brain Research Inst.

THIRD ANNUAL REPORT, JULY 1, 1963–JUN. 30, 1964

[1964] 149 p refs

(NASA-CR-62354) CFSTI: HC $4.00/MF $1.00

The activities of the Brain Research Institute are described and a brief account of its history and organization reported. Institute activities are considered under two main categories which include: (1) independent project research funded by grants assigned to individual investigators, and (2) collaborative research supported by program grants assigned to the institute or to investigators from different departments. Research activities such as project research on neurological disorders, program research including the Brain Information Service, and research training on graduate and postdoctoral level are reviewed as separate entities. Service activities emphasizing the role of the institute in serving the social and scientific community; facility requirements; publications of the institute; and operational support are also reviewed. S.C.W.

N65-22180*# Florida State Univ., Tallahassee. Inst. for Space Biosciences
POTENTIALITIES OF PROTEINOIDS FOR NUTRITIONAL INVESTIGATION
Sidney W. Fox, Kaoru Harada, Gottfried Krampitz, Tadao Hayakawa, and Charles Ray Windsor [1964] 16 p refs *Its* Contrib. No. 034
(Grant NsG-173-62)
(NASA-CR-56268) CFSTI: HC $1.00/MF $0.50

The possibility of chemical, nutritional, and engineering investigations through pansynthesis of proteinaceous compounds is discussed. Thermal synthesis of amino acid compositions from gaseous mixtures of methane, hydrogen, water, and ammonia in silica beds by electrical discharge is briefly outlined and observed results are shown in a table. Heating of dry amino acids containing sufficient proportions of dicarboxylic amino acids at 170° for about 6 hours, and subsequent hydrolysis as well as synthesis of amino acids by Leuchs anhydrides produced proteinoids that contained all the amino acids. Phenylalanine was used in the heating method, and histidine in the synthesis procedure. Chromatograms from a controlled pair of Leuchs anhydrides of the amino acids are shown. Proteinoids can be used instead of peptone by *Lactobacillus arabinosus* and by *Proteus vulgaris*. Their nutritional value can be viewed as synthetic generic protein. The Leuchs proteinoid may be of particular interest for missions requiring an optimally balanced nutritional polymer of amino acids. G.G.

N65-22189*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GLYCOGEN IN THE NERVOUS SYSTEM. I: METHODS FOR LIGHT AND ELECTRON MICROSCOPY
Rosita F. de Estable, Juan F. Estable-Puig (Univ. de la Rep., Montevideo), and Jaime Miquel [1964] 23 p refs Submitted for Publication
(NASA-TM-X-51741) CFSTI: HC $1.00/MF $0.50

Brain and spinal cord from 25 newborn chickens and 20 adult rats were used to study normal tissue and induced pathological conditions. The tissues were examined by light and electron microscopy. It was found that picroalcoholic fixatives preserve glycogen to a considerable degree but give an inadequate morphological image of glycogen distribution and the specimen is unsuitable for ultrastructural studies. Fixation with Dalton's chrome-osmic fluid seems adequate for ultrastructural cytochemistry of glycogen. Also, it permits routine paraffin embedding of brain slices adjacent to those used for electron microscopy. Enzymatic removal of glycogen in osmic fixed nerve tissue can be done in paraffin embedded tissue and in glycolmethacrylate embedded tissue without removal of the embedding medium. Further, paraphenylenediamine stains glycogen following acid oxidation. E.E.B.

N65-22195*# Ohio State Univ., Columbus. Environmental Physiology Lab.
EMBRYO DEVELOPMENT AND CHICK GROWTH IN A HELIUM–OXYGEN ATMOSPHERE
Harold S. Weiss, Ronald A. Wright, and Edwin P. Hiatt [1964] 33 p refs
(Grant NsG-295-62)
(NASA-CR-56876) CFSTI: HC $2.00/MF $0.50

Fertile chicken eggs were incubated in approximately 79% He–21% O_2 with up to 1% to 2% residual N_2 in a sealed, flexible, plastic isolator in which temperature, relative humidity, O_2 and CO_2 were controlled. Live, healthy chicks were hatched in He–O_2, but only half as many as in a comparable air system. The poorer He–O_2 hatch was due mainly to late embryonic death. Hatching time was similar, but the He chicks were 9% smaller. The He isolator required more electrical power to maintain incubation temperature, but had lower inside surface temperature. During development He embryos showed neither gross defects nor differences in dry wt or in N_2 concentrate, but He eggs lost 27% more wt. During an additional 4 weeks in their respective atmospheres, chick growth and hematology were similar, but the He birds consumed up to 16% more feed. Higher heart and respiratory rates, lower T_B and a tendency to huddle in He suggested that the increased feed intake might be in response to a higher metabolism, stimulated by a more rapid loss of body heat because conduction of heat is 6 1/2 × greater in He than N_2. Sudden removal of chicks into room air after 4 weeks in He–O_2 had no observable effect. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-21226*# Bunker-Ramo Corp., Canoga Park, Calif.
A BIBLIOGRAPHY OF RUSSIAN SCIENTIFIC AND TECHNOLOGICAL LITERATURE IN MANUAL CONTROL AND ASSOCIATED AREAS
C. M. Bertone Washington, NASA, Apr. 1965 137 p
(Contract NASw-869)
(NASA-CR-199) CFSTI: HC $4.00/MF $1.00

This report is a survey of 917 Soviet documents in the areas of manual control systems, human engineering, man in space, and associated areas. The information is reported in bibliographic form with an analysis of the findings and appropriate appendixes. Author

N65-21258# Bunker-Ramo Corp., Silver Spring, Md.
HUMAN ENGINEERING: PILOT FACTORS PROGRAM Final Summary Report, 1 Jan. 1963–30 Sep. 1964
W. F. Swartz Sep. 1964 52 p
(Contract AF 33(616)-7752)
(Rept.-1-64; AD-455013)

The compatibility of manual flying with an automatic flight control system approach using Force Wheel Steering as the connecting link was studied by means of oscillograph recordings and a standard display panel. Deterioration of the standard panel at 200 ft due to lack of information led to an additional study to determine the pilot's ability to fly through a 50-ft approach to gain additional information for the panel. The demonstrated reduction of pilot work load with force wheel steering suggests that the copilot be provided with a force wheel capability to establish the highest possible level of unburdening by means of integration of forced wheel and crew duties. The observed data were used in a rough draft of pilot preference as a function of gain, deadband, and bank angle. The consulting and planning activities of the support group for the Pilot Factors Program are also presented. G.G.

N65-21340*# California Univ., Los Angeles. Human Communication Lab.
THE DETECTION OF MARKOVIAN SEQUENCES OF SIGNALS Technical Report No. 23
Morton P. Friedman and Edward C. Carterette 15 Jul. 1964 23 p refs
(Grants NsG-237-62; PHS-MH-07809; Contract Nonr-233(58))
(NASA-CR-57928) CFSTI: HC $1.00/MF $0.50

The influence of constrained stimulus sequences on detection was studied in a two-alternative temporal forced-choice task with feedback. Three observers listened to a weak pure tone embedded in noise whose probabilities of occurrence and repetition in an interval were governed by a first-order Markov process. Each observer listened to examples of each of nine different Markov chains. Results were: (1) A single function relating detections to false alarms fitted individual sets of data well, in agreement with the theory of signal detectability, except that detection was higher for more extreme repetition probabilities. (2) Responses depended strongly on the previous stimulus with the dependence being peculiar to a given chain. (3) Detection probabilities increased during runs of signals in the same interval, yet probability of detection on the first trial of a run in a given interval did not depend on the length of the preceding run in the other interval. Author

N65-21399# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Multienvironment Div.

A RESTRAINT SYSTEM FOR APPLICATION IN R_Z AND $-G_x$ ACCELERATION ENVIRONMENTS WITH EMPHASIS UPON KNEE AND LOWER LEG RESTRAINTS Final Report, Dec. 1963–Feb. 1964

Robert E. Van Patten Dec. 1964 11 p
(AMRL-TR-64-144; AD-612957)

This report describes the development of a lower leg restraint system design suitable for use in yaw (R_Z) and transverse P-A G ($-G_X$) acceleration environments. The design is based upon the principle of avoiding restraining force concentrations along the anterior crest of the tibia and has been worn with comfort for periods of up to three minutes with the legs in a 9.8 G field. Author

N65-21479*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INTER-SENSORY JUDGMENTS OF SIGNAL DURATION

Trieve A. Tanner, Jr., R. Mark Patton, and R. C. Atkinson (Stanford Univ.) [1964] 11 p Presented at the Aerospace Med. Assoc. Meeting, Miami, Fla., 11–14 May 1964
(NASA-TM-X-51729) CFSTI: HC $1.00/MF $0.50

Visual and auditory signals were presented to 12 male subjects, free from gross impairment, for both inter- and intramodality comparisons of duration. Three base durations were investigated: t = 0.5, 1.0, and 1.5 sec; the difference increment Δt, was held constant at 0.1 sec, with only one base duration presented during a single session. Each signal consisted of a light or a tone, so that on any given trial the subject was presented either two lights, two tones, a tone followed by a light, or a light followed by a tone. A trial began with the onset of low intensity background noise and ended with its offset. Discrimination of signal duration was most accurate when two auditory signals were compared. Next in accuracy seem to have been judgments comparing the duration of two visual signals. Within the range of durations investigated, the tendency to judge the visual signal as longer than the auditory seems to increase for shorter base duration. Where signals of the same sensory modality are compared, the probability of the first signal being chosen is a function of $\Delta t/t$. E.P.V.

N65-21711# Joint Publications Research Service, Washington, D. C.

MAN IN A STATE OF WEIGHTLESSNESS (PSYCHOLOGICAL EXPERIMENTS)

A. Kitayev-smyk 23 Apr. 1965 16 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 9, Sep. 1964 p 16–21
(JPRS-29743; TT-65-30814) CFSTI: $1.00

The conditions under which weightlessness is experienced; the sensations of the phenomenon; reactions of individuals to this experience; and the physiology of the human are discussed. Experiments are used to show that under conditions of weightlessness the ability to work becomes less, the quality of the work decreases, and the time required to accomplish tasks increases. Also, the individual tends to overestimate his speed and the quality of the work done. Further, differences between individual experiences are examined. Knowledge of these peculiarities and deficiencies is applied in astronaut selection and training. E.E.B.

N65-21756*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF GUST-INDUCED AND MANEUVERING ACCELERATION STRESS ON PILOT-VEHICLE PERFORMANCE

Thomas E. Wempe [1963] 41 p refs Presented at the 35th Aerospace Med. Assoc. Meeting, Miami, Fla., 11–13 May 1964
(NASA-TM-X-51748) CFSTI: HC $2.00/MF $0.50

A piloted motion simulator study, using a height control simulator, was made to assess the effects of gust-induced and maneuvering acceleration stress on pilot performance in a low-level penetration attack mission. The ability of the pilot to maintain a relatively constant small ground clearance, while viewing aircraft instruments and a display depicting the terrain configuration ahead and below, was determined by changes in the following parameters: (1) moving cockpit versus fixed cockpit simulation; (2) subsonic versus supersonic simulated aircraft velocities; (3) calm air versus turbulent air conditions; (4) additional requirements for secondary task performance; (5) introduction of a bending mode frequency near the visceral resonance frequency; and (6) failure of an automatic terrain-following system monitored by the pilot. The results of each parameter variation are described, and substantiate the need for warning devices. G.G.

N65-21766*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

STUDIES OF MANUAL CONTROL SYSTEMS Progress Report No. 6, 19 Oct. 1964–18 Jan. 1965

19 Mar. 1965 37 p
(Contract NASw-668)
(NASA-CR-62251) CFSTI: HC $2.00/MF $0.50

Interaction in a two-axis, mixed-dynamic tracking task was investigated to determine if tracking performance in a given axis would differ when an axis was tracked alone and when an additional axis having dissimilar dynamics was simultaneously tracked. The normalized error in the position axis was more than doubled by the addition of the second axis. This effect was significant to below the 0.005 level. This increase in error was accompanied by a corresponding change in the human operator's describing function. There was also a 10% degradation in the acceleration axis in going from the single-axis to the two-axis task. Describing function graphs are presented. R.N.A.

N65-21882# Joint Publications Research Service, Washington, D. C.

CYBERNETICS, THOUGHT, AND LIFE

A. I. Berg et al 26 Apr. 1965 496 p refs Transl. into ENGLISH of the book "Kibernetika, Myshleniye, Zhizn'" Moscow, 1964 p 1–511
(JPRS-29764; TT-65-30825) CFSTI: $7.95

This collective monograph on cybernetics is divided into (1) cybernetics as a science; (2) cybernetics and life; (3) cybernetics and the study of cognitive psychic processes; and (4) cybernetics and problems of logic and methodology of scientific research. Soviet research on the methodological aspects of cybernetics is covered, and the contributions of philosophers and the various specialists in such fields as mathematics, logistics, biology, and psychology are discussed. G.G.

N65-22120# Joint Publications Research Service, Washington, D. C.
PERFORMANCE RELIABILITY OF MEDICAL ELECTRONIC EQUIPMENT AND BIOELECTRICALLY CONTROLLED PERFUSION PUMP
Yu. P. Sokolovskiy and M. A. Belilovskiy 30 Apr. 1965 23 p refs Transl. into ENGLISH from Med. Prom. SSSR (Moscow), no. 2, Feb. 1965 p 17–23, 58-63
(JPRS-29836; TT-65-30859) CFSTI: $1.00

CONTENTS:
1. DETERMINING PERFORMANCE RELIABILITY OF MEDICAL ELECTRONIC APPARATUS Yu. P. Sokolovskiy p 1–11 refs
2. A PERFUSION PUMP WITH BIOELECTRIC CONTROL M. A. Belilovskiy p 12–20 refs

N65-22190*# National Aeronautics and Space Administration, Washington, D. C.
HUMAN FACTORS IN ELECTRONICS
Eugene B. Konecci [1964] 6 p Presented at the 5th Ann. Meeting, Profess. Tech. Group in Human Factors Eng., IEEE, San Diego, Calif., 5–6 May 1964
(NASA-TM-X-51735) CFSTI: HC $1.00/MF $0.50

Eugene B. Konecci, Director, Biotechnology and Human Research, NASA, stated that the greatest contribution the combined fields of human factors and electronics can make is in the area of cybernetics; the essence of this combination reduces to the fact that what the human brain is and what it actually does must be understood. Human factors also must be considered and stated in terms of the potential effects upon total system effectiveness. It was further stated that the greatest need in human factor research is a better understanding of man, his capabilities, and his limitations. E.E.B.

N65-22198*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
THE ROLE OF FEEDBACK IN ADAPTIVE PERCEPTUAL PROCESSES
Ronald A. Kinchla and Richard C. Atkinson [1964] 4 p Presented at the 35th Ann. Meeting of the Aerospace Med. Assoc., Miami Beach, Fla., 11–14 May 1964
(NASA-TM-X-51737) CFSTI: HC $1.00/MF $0.50

Factors which influence an observer when he attempts to identify partially discriminable stimuli were investigated. In the experiment described, each observer attempted to discriminate whether or not a 100-msec, 1000-cps tone was, or was not, added to a constant background of band limited Gaussian noise. The experiment is discussed in detail and the results are given. It was found that the subjects learn to utilize higher order statistical properties of the stimulus presentation schedule in their performance. Also, with no feedback, the sequential effects appear to be attenuated and based primarily on the proceeding response, rather than the proceeding stimulus as was the case with feedback. E.E.B.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-21166*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
METHOD OF DETERMINING CARBONATE ION IN SURFACE OF CRYSTALLINE SOLIDS BY MEANS OF MASS SPECTROMETRIC GAS ANALYSIS
Dumas A. Otterson and Myron O. Davies Washington, NASA, Apr. 1965 9 p refs
(NASA-TN-D-2764) CFSTI: HC $1.00/MF $0.50

A method which is applicable to most solids was developed for the determination of carbonate present in the surface of sodium chloride. It entails the liberation of carbon dioxide by a reaction with hydrogen chloride vapors in a previously evacuated chamber and the analysis of the resulting gas mixture mass spectrometrically. The carbon dioxide liberated at room temperature originates in the surface layer while at elevated temperatures some may come from subsurface layers. Comparison with an earlier method in which water was used to liberate carbon dioxide demonstrates the greater reliability of the hydrogen chloride method. Author

N65-21221 Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH ON NEW HEAT-RESISTANT POLYMERS—POLYBENZIMIDAZOLES
Boris Nartsissov *In its* Foreign Sci. Bull., Vol. 1, No. 3 Mar. 1965 p 14–22 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

Soviet interest in a new class of exceptionally heat-resistant polymers, polybenzimidazoles, was reflected in an analysis of the literature published during 1964; 10 articles were noted on polybenzimidazoles and related subjects. The studies are briefly reviewed, and references to U. S. studies, copied or varied by Soviet scientists, are included. Author

N65-21240# Argonne National Lab., Ill.
GRAVIMETRIC METHOD FOR THE DETERMINATION OF THORIUM AND PHOSPHORUS IN THORIUM PHOSPHIDES
R. E. Telford and Y. Baskin Feb. 1965 11 p refs
(Contract W-31-109-ENG-38)
(ANL-7005) CFSTI: $1.00

Thorium was precipitated as the oxalate and ignited to the oxide after dissolving the sample in a HNO_3-Br_2 solution. Phosphorus was determined in the filtrate by precipitation and weighing as $MgNH_4PO_4 \cdot 6H_2O$. Author

N65-21246# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
EXTRACTION OF GERMANIUM FROM FLY ASH
N. S. K. Prasad, K. M. Abubacker, T. Keshavadas, and C. T. Mehta 1964 17 p refs
(AEET/CD/25)

The possibility of obtaining germanium from flue dust of burnt coal processing was investigated by various extraction and purification methods. It was observed that the germanium content of the flue dust samples depended on the origin of the coal and the location of the flue dust in the boiler

environment. Fly ash samples from various power houses and factories, and some samples of lignite, coal, zinc ore, columbite, etc., were analyzed, and the results are presented in tables. G.G.

N65-21248# Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF HYDROGEN IN MOLYBDENUM METAL
Ross D. Gardner, William H. Ashley, and Paul Bergstresser 24 Mar. 1965 12 p refs
(Contract W-7405-ENG-36)
(LA-3225) CFSTI: $1.00

The combustion-gravimetric method for the determination of hydrogen was modified and adapted to the measurement of hydrogen in molybdenum metal. The sample is burned in oxygen at 1100° C. Fused magnesium oxide sand is used to absorb the molybdic oxide produced and prevent its sublimation in the combustion tube. The water produced by oxidation of the hydrogen present is absorbed in anhydrous magnesium perchlorate and weighed. An average recovery of 99.1% with a standard deviation of 8 ppm was obtained for the analysis of 62 samples containing known amounts of hydrogen in the 10- to 500-ppm range. Author

N65-21273# Texas Univ., Austin. Dept. of Chemistry
ENERGY DISSIPATION FROM EXCITED STATES OF POLYATOMIC MOLECULES
W. Albert Noyes, Jr. 1964 22 p refs Presented at the Acad. das Cienc. de Lisboa, Portugal, 7 May 1964
(AFOSR-64-2433; AD-610077)

Having postulated mechanisms of energy dissipation for polyatomic molecules (e.g. benzene, biacetyl, and acetone) based on the existence of excited states of different multiplicities of spin, the existing, experimental results, in spite of being scarce, seem to confirm the proposed hypotheses. Finally, forecasts are made on the behavior of the cetene molecule that, when subject to radiations of different wavelengths, originates the radicals CH_2 in excited states with different multiplicities of spin. Author

N65-21281# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
A NEW METHOD OF PREPARING CARRIER-FREE PHOSPHORUS 32 ORTHOPHOSPHATE [UN NUEVO METODO DE PREPARACION DE ^{32}P SIN PORTADOR]
R. P. Goso and R. Radicella 1964 12 p refs In SPANISH
(Rept.-128)

The paper describes the method utilized for preparing carrier-free ^{32}P-orthophosphate by solution of the irradiated sulfur in carbon sulfide, followed by the adsorption of phosphorus-32 in a powered glass column and elution with distilled water. The chemical yield is 90%. The radioactive purity is better than 99.95%, and the radiochemical purity is higher than 99.5% after heating the solution (0.01 N hydrochloric acid) for 1 hour, at 120° C. Author

N65-21310*# Dow Chemical Co., Midland, Mich.
SYNTHESIS AND CHARACTERIZATION OF MODEL POLYMERS FOR USE IN THE INVESTIGATION OF CHAR FORMING HEAT SHIELDS Status Report No. 1
Elmer L. Pendleton Jan. 1965 8 p
(Contract NAS7-344)
(NASA-CR-57811) CFSTI: HC $1.00/MF $0.50

Large lots of both D.E.N. 438 epoxy novolac resin and Nadic methyl anhydride (NMA) were obtained. Sufficient amounts of DMP-30 and benzyl dimethyl amine catalysts were obtained. The greater part of analytical results on the D.E.N. 438 and NMA have been obtained. Molds were fabricated to mold 1 1/2 in. by 6 in. sample billets. Author

N65-21327*# General Electric Co., Evendale, Ohio. Materials Development Lab. Operation
BROMINE TRIFLUORIDE METHOD FOR OXYGEN IN LIQUID ALKALI METALS Final Report, Jan. 1, 1964–Mar. 31, 1965
Hyman Kirtchik and Siegmond Culp 31 Mar. 1965 81 p refs
(Contract NASw-882)
(NASA-CR-57951) CFSTI: HC $3.00/MF $0.75

Potassium is analyzed for oxygen by reacting samples of the metal with bromine trifluoride in a specially constructed monel reaction vessel. The oxygen thus liberated is purged from the reaction cell with helium and mixed with an alkaline solution of sodium anthraquinone β-sulfonate in a modified Brady apparatus. The resulting color change of the reagent solution is measured with a recording spectrophotometer, the change in absorbance being related to the oxygen content by means of a previously prepared calibration curve. Reproducibility of the method is good with coefficients of variation ranging from 1% to 13%. Essentially, complete oxygen recovery is obtained from potassium bromate synthetic samples, while potassium carbonate additions show the method, as used, to be insensitive to carbonates. The apparatus blanks are in the order of 5 to 10 μg of O_2. Recommendations are given for apparatus changes and more particularly for application of this BrF_3 method to other alkali metals. Author

N65-21333*# Southern Research Inst., Birmingham, Ala. Organic Section
A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Progress Report, Nov. 4–Dec. 3, 1964
Robert E. Burks, Jr., Richard S. Johnson, and Thomas W. Ray 15 Dec. 1964 22 p refs *Its* Rept.-45
(Contract NAS8-1510)
(NASA-CR-57908) CFSTI: HC $1.00/MF $0.50

Studies of diphenylsiloxane–silphenylenesiloxane elastomers, and of silphenylene amine polymers were continued. The elastomers were found to have combined thermal and physical properties superior to elastomers prepared previously in this program. The *meta*-oriented units were found to increase the elasticity and reduce the crystallinity of silphenylene amine polymers without adversely affecting thermal stability. The reactions of carbon disulfide and carbon dioxide with methylaminosilanes, and the reactions of Grignard reagents of cyclic silazanes with silicon halides were investigated for the preparation of polysilazanes, but were found to be unsatisfactory. Author

N65-21357*# Stanford Research Inst., Menlo Park, Calif.
VACUUM ULTRAVIOLET IRRADIATION OF POLYBUTADIENE Final Report
Morton A. Golub 15 Feb. 1965 33 p refs
(Contract NASr-49(20); SRI Proj. PRU-5127)
(NASA-CR-57875) CFSTI: HC $2.00/MF $0.50

Polybutadiene in the solid state undergoes photochemical *cis-trans* isomerization, in the absence of deliberately added sensitizer, when irradiated in vacuo with krypton 1236 Å or mercury 2537 Å radiation. The isomerization is accompanied by loss of unsaturation. The quantum yields for these two reactions in the case of krypton radiation were found to be 0.25 and

1.53, respectively, while the corresponding yields for the mercury irradiation were 0.09 and 0.07. The rather high G-values or 100-eV yields for the vacuum photochemical isomerization and the loss of double bonds (2.5 and 15.3) compare well with corresponding G-values for the radiation chemical analogs (7.2 and 13.6-7.9, respectively), thus calling attention to the likely similarity of mechanisms in these two systems. In particular, the high quantum yield or G-value for loss of double bonds with krypton irradiation strongly indicates a chain cyclization comparable to that postulated in the radiation chemistry of diene polymers. Author

N65-21368# Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Special Training Div.

COBALT MOLYBDATE CATALYST FOR AMBIENT TEMPERATURE SYNTHESIS OF BENZENE FOR LIQUID SCINTILLATION RADIOCARBON DATING

John E. Noakes, Stephen M. Kim, and L. K. Akers Apr. 1965 16 p refs
(Contract AT(40-1)-GEN-33)
(ORINS-50) CFSTI: $1.00

A method for synthesizing acetylene gas to liquid benzene in quantitative yields for liquid scintillation radiocarbon dating has been developed. The ambient temperature catalysis is accomplished using a cobalt molybdate alumina catalyst which requires no pretreatment other than dehydration. The synthesized benzene has been checked by gas chromatography and infrared analysis and found to be pure. The $^{13}C/^{12}C$ mass spectrometric analysis of the benzene and the acetylene from which it was derived shows no carbon isotope fractionation. Author

N65-21379*# Unified Science Associates, Inc., Pasadena, Calif.

GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS First Quarterly Report, 21 Aug.–20 Nov. 1964

S. Naiditch, J. J. Rowlette, and E. L. Colichman [1964] 29 p refs
(Contract NAS7-326)
(NASA-CR-57874) CFSTI: HC $1.00/MF $0.50

The objective of this program is to evaluate the applicability of dense gaseous electrolytic solutions to energy conversion. The electrochemical cell Zn(Hg), $ZnCl_2 \cdot 10NH_3(s)$, NH_4Cl in NH_3, Cd $Cl_2 \cdot 6NH_3(s)$, Cd(Hg) was chosen to initiate this study. Preliminary electromotive force and electrical conductance measurements have been obtained over the temperature range −64° to +152° C; both liquid and gaseous electrolytic solutions have therefore been studied. Some initial runs were performed outside the pressure system at room temperature (25° C) and at −64° to −54° C to check out the electrochemical cell assembly. The EMF's obtained were +0.360V at 25° C and +0.356V at −54° to −64° C. These early results with liquid electrolytic solutions are in reasonable agreement with accepted classical results. The value reported in the literature for the standard potential is 0.3605V at 25° C and increases with temperature. Author

N65-21394# Mound Lab., Miamisburg, Ohio.

MOUND LABORATORY PROGRESS REPORT FOR DECEMBER, 1964

J. F. Eichelberger, G. R. Grove, and L. V. Jones 7 Apr. 1965 46 p refs
(Contract AT-33-1-GEN-53)
(MLM-1231)

CONTENTS:

1. RADIOELEMENTS p 6–15 refs
2. ISOTOPE SEPARATION AND PURIFICATION p 16–33 refs
3. ANALYTICAL AND INSTRUMENTATION p 34–44 refs

N65-21416# Los Alamos Scientific Lab., N. Mex.

SPECTROPHOTOMETRIC DETERMINATION OF RHENIUM IN TANTALUM-RHENIUM ALLOYS

K. S. Bergstresser 24 Mar. 1965 13 p refs
(Contract W-7405-ENG-36)
(LA-3213) CFSTI: $1.00

A method is described for the determination of 1% to 6% rhenium in binary alloys of tantalum. Samples of alloy are dissolved with hydrofluoric acid and a mixture of hydrochloric acid and hydrogen peroxide. After excess acid and peroxide are removed by evaporation, an aliquot of the dissolved sample containing no more than 200 μg of rhenium is used for color development. The fluoride in a properly diluted aliquot is complexed with borate, and rhenium is reduced with stannous chloride in the presence of the color reagent, furil dioxime. Absorbance of the red, rhenium–dioxime complex is measured with a spectrophotometer at 532μ. The standard deviation of a single measurement was estimated to be 0.5 μg of rhenium from data obtained in analyzing 16 solution samples containing tantalum and from 20 to 200 μg of rhenium. The method was successfully applied to the analysis of 1% and 5% tantalum–rhenium alloys. Author

N65-21431# National Lead Co. of Ohio, Cincinnati. Technical Div.

ANALYTICAL CHEMISTRY MANUAL OF THE FEED MATERIALS PRODUCTION CENTER

Dec. 1964 335 p refs Sponsored by AEC
(TID-7022, Vol. I-Book 2) CFSTI: $3.50

A compilation of analytical methods employed for the production of high-purity uranium metal to determine the chemical composition and physical characteristics of process samples is presented in two sections. The wet chemical section uses gravimetric, volumetric, physical–chemical, or gasometric methods; the instrumental analytical section applies instrumentation and methods designed to determine the chemical and nuclear composition of substances by the measurement of specific physical properties or attributes. G.G.

N65-21441# Royal Aircraft Establishment, Farnborough (England).

THE SOLUBILITY OF SILICON TETRAFLUORIDE IN HYDROGEN FLUORIDE AND ANALYSIS OF LIQUID HYDROGEN FLUORIDE [RASTVORIMOST' CHETYREKHFTORISTOGO KREMNIYA VO FTORISTOM VODORODE I ANALIZ ZHIDKOGO FTORISTOGO VODORODA]

N. S. Nikolaev Jan. 1965 13 p refs Transl. into ENGLISH from Izv. Sekt. Fiz-Khim. Anal.º Akad. Nauk SSSR (Moscow), v. 25, 1954 p 375–380
(RAE-LIB-TRANS-1092)

The compositions of solutions in the hydrogen fluoride-rich region of the H_2O–SiF_4–HF system at 15° C were determined by a new combination of known methods. The results are compared with previous data on the system, and show that with hydrogen fluoride concentrations above 96% the solubility of silicon tetrafluoride is very small. Author

N65-21447# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.

IONIZATION DETECTORS IN GAS CHROMATOGRAPHY

J. Krugers (Thesis—Eindhoven Tech. Univ., 1964) 1965 142 p refs *Its* Res. Repts. Suppl. No. 1

A description of the more important types of ionization detectors in gas chromatography is given. A series of instruments for the testing of detectors has been further developed; a description is given. A few electronic aids are dealt with; results obtained with these instruments are given. The conclusions drawn are: (1) The flame ionization detector is a nearly ideal detector; its simple operation seems to have excluded its complicated mechanism. (2) The importance of adjustment of the gas velocities for the flame ionization detector to optimum values has been underestimated. A large dynamic range appeared to demand a minimum critical value of the nitrogen gas velocity. (3) Detectors giving a Gaussian noise require an amplifier with a variable time constant to provide the minimum detection limit for every peak width. (4) A logarithmic gas dilution system has been further developed; its improvement was of great value in measuring the response of a detector as a function of the concentration of the component. (5) A detector using an excitation reaction instead of an ionization reaction may have better characteristics than existing detectors. Author

N65-21454# Technische Hochschule München (West Germany). Radiochemical Inst.

THE MECHANISM OF MOLECULAR FORMATION BY NUCLEAR FISSION AND SUBSEQUENT PROCESSES IN SOLID MIXTURES

H. J. Born Brussels, EURATOM, 1964 21 p

(Contract EURATOM-031-62-9-RISD)

(EUR-2209.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

By tests in temperatures from 4° to 500° K it was shown that, at least in the formation of new $^{105}Ru\ (C_5H_5)_2$ from uranium fission products and an appropriate capture compound in the solid phase, the following are not concerned: a collision substitution by primary fission products, unstable intermediate products, conventional chemical reactions, thermal radical reactions, or radiation-induced reactions. The actual cause of new molecule formation is the β-decays of the fission products. The function of the primary fission recoil is merely to transport the fission atoms into the admixed capture compound. The molecule synthesis as a result of β-decays is not a high-energy recoil process but occurs in energy ranges in which the chemical binding energies in the capture compound already play a substantial part. Author

N65-21490# Laboratoires du Centre d'Etude de l'Energie Nucléaire, Mol (Belgium).

ELECTRODIALYSIS AS AN AUXILIARY IN THE SEPARATION OF Cs AND Sr FROM ACID FISSION PRODUCT SOLUTIONS

A. Guery (Israel Atomic Energy Comm.) and L. H. Baetsle Brussels, EURATOM, 1964 14 p refs

(Contract EURATOM-028-62-4 RISB)

(EUR-2199.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

A study was performed on the use of electrodialysis as a means for deacidulation and desalination of high-level reprocessing waste solutions. Two types of electrodialysis cells were investigated—the two- and the three-compartment cells. The first type proved to be inadequate for deacidulation purposes because of the high ammonia formation in the catholyte which impedes subsequent ion exchange processes. A three-compartment cell turned out to be much more suitable if the feed solution did not contain appreciable amounts of salts. An amount of phosphoric acid equivalent to the total amount of bulk ions has to be added in order to avoid precipitation in the feed compartment. A special electrodialysis cell was designed for the desalination of ammonium nitrate solutions being used as eluting for Cs from mineral ion exchangers. The feed solution is brought into the cathode compartment, and the semipermeable membrane is made of fired clay. The passage of current through the membrane with high electrical resistance carries nitrate ions and heats this cell, leaving an ammonia solution which evaporates. Author

N65-21494# Pennsylvania State Univ., University Park. Dept. of Chemistry

INDUCTIVE EFFECTS IN GAS PHASE LEWIS ACID-BASE EQUILIBRIA; AND, THERMODYNAMIC RATE PROPERTIES FOR THE ACID-CATALYZED PROPYLENE-ISOPROPYL ALCOHOL INTERCONVERSION Final Report

Robert W. Taft Sep. 1964 22 p refs

(Contract Nonr-656(05))

(AD-610086)

The linear inductive energy relationship, $\log (k/k_o) = \sigma_I \rho$ was previously developed, and the applicability of this relationship in the gas phase is discussed. The series of Lewis acid-base equilibria selected for study is represented by

$$XCH_2NH_2(g) + B(CH_3)_3(g) \rightleftharpoons XCH_2\text{—}\underset{\displaystyle H}{\overset{\displaystyle H}{\underset{|}{\overset{|}{N}}}}\text{—}B(CH_3)_3(g)$$

where X is a polar substituent. The thermodynamic properties were determined. In order to obtain the thermodynamic rate properties for the acid–catalyzed propylene–isopropyl alcohol interconversion, the rate of hydration of propylene at unit pressure was measured in 35.9 to 62.2 weight percent perchloric acid at 10° intervals over the range 20° to 60°. The rate constants obtained are summarized. Also, activation parameters are presented, and the extrapolated enthalpies and entropies of activation at common acidity and temperature for propylene and isobutylene are tabulated. E.E.B.

N65-21525# European Atomic Energy Community, Brussels (Belgium).

DETERMINATION OF ALUMINUM OXIDE IN SAP POWDERS AND SINTERED PRODUCTS; CRITICAL EXAMINATION OF OTHER ANALYTICAL METHODS [DETERMINAZIONE DELL'OSSIDO DI ALLUMINIO NELLE POLVERI E NEI PRODOTTI FINITI SAP; ESAME CRITICO DEI DIVERSI METODI ANALITICI]

G. Serrini, J. Collin, and W. Leyendecker 1965 22 p refs In ITALIAN; ENGLISH summary

(EUR-2207.i) Available from Belg. Am. Bank and Trust Co. New York, Account No. 22.186: 40 Belg. Fr.

The determination of aluminum oxide in SAP powder and sintered products is described. The method employed is the separation of aluminum metal by gaseous hydrochloric acid. Some modifications applied to the original method have improved and hastened the determination of these samples. The coefficient of variation of the method is ±1.5% for sintered products and ±2% to 3% for powders. A critical examination of the other methods is also reported. Author

N65-21533# Atomic Energy of Canada, Ltd., Pinawa (Manitoba).
THE DETERMINATION OF FLUORINE IN POLYPHENYL REACTOR COOLANTS
R. B. Stewart and D. M. Wuschke Dec. 1964 15 p refs
(AECL-2136) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

A method for the analysis for fluorine in polyphenyls and other organic compounds is described. It consists of a decomposition of the organic matrix by combustion in an oxyhydrogen flame, condensation of the water vapor and hydrofluoric acid produced, concentration and purification of this acid by ion exchange, and determination of the fluoride content by spectrophotometry. Fluoride contents as low as 0.1 parts per million may be measured. Author

N65-21542# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING BORON NITRIDE
G. V. Samsonov, M. G. Koval'chenko, and V. M. Sleptsov 23 Apr. 1963 4 p Transl. into ENGLISH from Russian Patent no. 129647 (Appl. no. 641773/23), 19 Oct. 1959 p 1–2
(FTD-TT-63-65/1; AD-415662)

A method for the preparation of boron nitride by double stage nitration at 1500° and 1700° C of 85 wt% of boric acid and 15 wt% of carbon (lamp black) is described. The degree of purity and the yield of final product are both increased in the method proposed. The boric acid is first dehydrated in the presence of the carbon by calcination in open air in a step-by-step process which is described. The obtained sinter is then ground, sifted, and nitrated. The boron nitride obtained by this method had the following composition in weight percent: boron 42.8% to 43.7%; nitrogen 55.6% to 65.4%; and carbon 0% to 0.5%. The yield of the product when converted into pure boron was 75% to 80%. E.E.B.

N65-21548# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KINETIC EQUATIONS OF HOMOGENEOUS REACTIONS
R. Zahradnik 3 Mar. 1965 100 p refs Transl. into ENGLISH from Chem. Listy (Czechoslovakia), v. 53, 1959 p 56–103
(FTD-TT-64-652/1+2; AD-458232)

The results of papers dealing with the kinetic equations of homogeneous reactions are summarized. The kinetic schemes are classified according to the order of reaction, the number of components, and the fullness of the scheme. At the greater of the schemes the dependence of the concentration of components on time and the method of calculation of velocity constants are discussed. In conclusion, the prospects of this field of chemical kinetics are pointed out. Author

N65-21551# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS TO POISON METAL CATALYSTS. II: POISONING NICKEL CATALYSTS WITH OXYGEN
Horst Kinza, Wolfgang Fiebig, Joachim Reichelt, and Peter Starke 19 Mar. 1965 24 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 329, 1964 p 146–162
(FTD-TT-65-160/1+2; AD-460494)

By measurements of the alteration of the catalytic activity and the electrochemical hydrogen potential, the poisoning of liquid-phase hydrogenation systems containing Ni catalysts by oxygen was investigated. From the data obtained, conclusions about the kind of hydrogen–catalyst bonding and the reaction stages are drawn. Author

N65-21634*# National Aeronautics and Space Administration, Washington, D. C.
THE POLYMERIZATION OF ACROLEIN AND ITS DERIVATIVES [POLIMERIZATSIYA AKROLEINA I YEGO PROIZVODNYKH]
I. V. Andreyev, M. M. Koton, and K. A. Kovalev Apr. 1965 11 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 4, no. 4, 1962 p 528–532
(NASA-TT-F-9341) CFSTI: HC $1.00/MF $0.50

Low-temperature polymerization of acrolein and derivatives under various conditions and resultant polymers were studied. It was established that a-methylacrolein is polymerized more slowly than acrolein. Author

N65-21692# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
ACTINIDE DIFFUSION IN PYROCARBONS AND GRAPHITE—A SUMMARY REPORT ON THIN-LAYER EXPERIMENTS
R. B. Evans, III, J. O. Stiegler, and J. Truitt Dec. 1964 91 p refs
(Contract W-7405-ENG-26)
(ORNL-3711) CFSTI: $3.00

An important phase of an experimental investigation of actinide migration in pyrolytic carbon was completed. This work involved the determination of diffusion coefficients for thorium, protactinium, and uranium as a function of temperature by employment of the classical instantaneous-source-layer technique. The massive pyrolytic carbon investigated possessed a columnar microstructure composed of highly oriented turbostratic crystallites; such a structure leads to the unusual anisotropic characteristics associated with materials of this type. Thus determination of two sets of coefficients was required—one for diffusion perpendicular to the deposition plane, and another for diffusion parallel to this plane. The experiments were designed to provide data over the temperature range 1000° to 2400° C, which included three distinct migration regimes. Migration was found to be negligible below a threshold temperature of 1460° C. Above the threshold temperature, but below 1900° C, the migration could be described by applicable diffusion equations. At temperatures above 1900° C, effects of structural changes, within the carbon matrix, intruded into the diffusion process such that the apparent coefficients decreased with increased diffusion anneal times. Author

N65-21696# Brookhaven National Lab., Upton, N. Y.
Co^{60} GAMMA RADIATION INDUCED COPOLYMERIZATION OF ETHYLENE AND CARBON MONOXIDE
P. Colombo, L. E. Kukacka, J. Fontana, R. N. Chapman, and M. Steinberg Oct. 1964 59 p refs
(BNL-8554)

The Cobalt-60 gamma radiation induced copolymerization of ethylene and carbon monoxide was investigated over a wide range of conditions as follows: (1) initial gas mixture compositions from 100% ethylene to 100% CO, (2) pressures from 170 to 680 atm, (3) radiation intensities from (0.76 to 6.09) $\times 10^5$ rad/hr, (4) total doses from 0.47 to 2.5 $\times 10^6$ rad, and (5) temperatures from 20° to 200° C. At 20° C, concentrations up to 1% CO retard the polymerization of ethylene. Higher CO concentrations show an increasing polymerization rate. The rate and G value exhibit a maximum in the same order as that for pure ethylene in the range of 30% to 40% CO. Author

N65-21714# Battelle Memorial Inst., Columbus, Ohio.
PHASE, THERMODYNAMIC, OXIDATION, AND CORROSION STUDIES OF THE SYSTEM URANIUM–NITROGEN
Josef Bugl and Arthur A. Bauer 4 Sep. 1964 42 p refs
(Contract W-7405-ENG-92)
(BMI-1692; EURAEC-1210) CFSTI: $1.00

The pressure-temperature dependence of UN decomposition and melting, of equilibrium between the UN and U_2N_3 phases, and of nitrogen solution in the U_2N_3 phase was determined as well as the solubility of UN in liquid uranium. From the experimental data, thermodynamic functions for the formation of U_2N_3 from UN and nitrogen gas and for the solution of nitrogen in U_2N_3 were determined. For the latter, integrated thermodynamic functions for the solution of nitrogen in U_2N_3 were calculated. The oxidation kinetics of UN in CO_2, oxygen, and water-saturated air were found to obey the linear weight-gain law with activation energies ranging from 10400 to 15400 cal per mole. The oxidation product in atmospheric gas at temperatures of 300° C and greater was U_3O_8. UN corroded in 300° C water to form UO_2, but the rate of corrosion was highly sensitive to stoichiometry and to density with cast, 100% dense, stoichiometric UN exhibiting optimum corrosion resistance as compared with nonstoichiometric UN prepared either by casting or by powder metallurgy. Corrosion rates in 100° C water, 350° C Santowax R, and 820° C NaK were low or negligible. Author

N65-21716# Mound Lab., Miamisburg, Ohio.
PLASMA SPHEROIDIZED ZIRCONIA
D. B. Sullenger and K. D. Phipps 11 Dec. 1964 19 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1205) CFSTI: $1.00

The induction-coupled plasma torch was utilized to prepare microspheroids of zirconium dioxide and plutonium dioxide–zirconium dioxide. Powder X-ray diffraction photographs of the zirconium dioxide microspheroidized in a 50% argon–50% oxygen atmosphere indicated the presence only of the monoclinic form with typical lattice parameters. Several of the more transparent 100-micron diameter spheres were highly strained single crystals, as revealed by Laue photography, and exhibited approximate monoclinic lattice parameters. One sphere oriented so as to exhibit four-fold internal symmetry yielded tetragonal lattice parameters of a = 3.64 Å, c = 5.24 Å via precession and Weissenberg photography. Under 2537 Å and 3650 Å ultraviolet light an appreciable variation in fluorescence was noted for a few individual spheres. The density of the zirconium dioxide microspheres was approximately 5.5 g per cm^3. The high temperature form of zirconium dioxide was stabilized with 27 mole% plutonium dioxide. The stabilized product has a body centered tetragonal lattice with parameters of a = 3.622 Å; c = 5.192 Å. Fifty mole percent plutonium dioxide produced a cubic lattice with a = 5.261 Å. Author

N65-21750# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
INTERMOLECULAR FORCES
Joseph O. Hirschfelder 23 Sep. 1964 41 p refs
(Grant NIH GM-11315-01)
(WIS-TCI-66)

It is difficult to provide a quantitative explanation of the forces between biologically active molecules because these molecules are large, complex, and immersed in an aqueous solution. There are seven types of intermolecular forces which must be considered: (1) direct electrostatic, (2) polarization or induced, (3) dispersion or fluctuation, (4) resonance, (5) valence or chemical, and (6) magnetic and relativistic. Each of these is considered in detail and the effects of solvation are discussed. Author

N65-21755# Southwest Research Inst., San Antonio, Tex.
A STUDY OF RAPID SOLIDIFICATION OF HYDROCARBON FUELS Final Report
Eugene C. Martin Ft. Eustis, Va., Army Transportation Res. Command, Feb. 1965 170 p refs
(Contract DA-44-177-TC-819)
(TRECOM-TR-64-66; AD-613077)

The most promising systems consist of amines and diisocyanates. The properties of the gel are influenced by the structure of the amine and isocyanate. Various types of gels can be produced. These include particulate, viscoelastic, and dilatant gels. Gelation rates as fast as 0.04 sec were obtained. In addition, several systems will rapidly gel fuel from −55° to 60° C. The results show that the various gels will retard the burning rate of the fuels and will contain the fuel while burning. The viscoelastic and dilatant gels have excellent impact properties. The gelation of aircraft fuel will significantly decrease the fuel vaporization rate. A comparison was made of the various gels prepared. Some of the gels are almost as effective at 2.5 wt% concentration as at a concentration of 4.0 wt%. Author

N65-21757*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VISIBLE ABSORPTION SPECTRA OF SODIUM IN SODIUM IODIDE
J. Greenberg and I. Warshawsky 19 May 1964 5 p refs Submitted for Publication
(NASA-TM-X-51789) CFSTI: HC $1.00/MF $0.50

Visible absorption spectra of a saturated solution of Na in NaI were obtained with a peak at approximately 670 mμ at 675° C that does not appear to be a function of F-center formation. The solution became completely opaque and no peak structure was observed at a temperature increase to 700° C leading to the conclusion that sodium atoms and molecules do absorb in the region of the observed band. It appears that the alkali metal in dilute solutions interacts with the melt to form an F-center; appears in terms of the atomic and molecular species as the concentration of the metal increases; and becomes finally opaque in the visible region typical of the metallic state upon further concentration increase. G.G.

N65-21789# Monsanto Research Corp., Dayton, Ohio. Mound Lab.
MOUND LABORATORY PROGRESS REPORT FOR JANUARY, 1965
J. F. Eichelberger, G. R. Grove, and L. V. Jones 15 Apr. 1965 40 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1238)

Work was done in the following areas of research: *Radioelements*—polonium-208/polonium-209, uranium-234, half-life of plutonium-238, and half-life determination by decaying pairs for polonium; *Alpha and Neutron Source Development*—neutron measurements of $Pu^{238}Be$ sources; *Isotope Separation and Purification*—carbon-13, helium, neon, argon, krypton, and xenon; *Thermal Diffusion*—molecular beam scattering, and helium research; *Analytical and Instrumentation*—polarographic procedure for lead, tin, and indium, and oxygen analysis of beryllium oxide encapsulated in a rabbit. G.G.

N65-21791# Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF GALLIUM IN HIGH-PURITY PLUTONIUM METAL
Ross D. Gardner, Charles T. Apel, and William H. Ashley 27 Mar. 1965 15 p refs
(Contract W-7405-ENG-36)
(LA-3248) CFSTI: $1.00

The rhodamine B method for the spectrophotometric determination of gallium was modified and applied to the determination of trace amounts of gallium in high-purity electrolytic plutonium metal. In this method the plutonium is dissolved in hydrochloric acid and the chlorogallate–rhodamine B complex is extracted into a 3:1 mixture of chlorobenzene and carbon tetrachloride without any preliminary separation of the plutonium. The absorbance of the extract is measured at 562 mμ. Forty-two determinations made on plutonium solutions containing from 0.5 to 100 ppm of gallium showed a standard deviation of 2% relative or 0.1 ppm, whichever was larger. Some care is necessary to assure that the volume and acidity of the aqueous phase is reproduced each time, but the manipulations are simple and little time is required. Interference from plutonium and from other elements commonly found in high-purity plutonium metal was negligible. Author

N65-21794# Atomic Energy of Canada, Ltd., Chalk River, Ontario.
REMOVAL OF CHLORINE FROM ORGANIC COOLANT
J. H. Duerksen Aug. 1964 28 p refs
(AECL-1912; CRCE-1118) Available from Atomic Energy of Canada, Ltd., Chalk River, Ontario: $2.00

Chlorine removal tests were done in capsules, in small loops, in the out-reactor 250-0-1 loop, and in the X-7 loop in NRX. These showed that once chlorine entered an organic-cooled steel system it was not quickly or easily removed, emphasizing the importance of control to insure its exclusion. The mild- and stainless-steel surfaces readily picked up some forms of chlorine contamination from the coolant. The most successful solid removers tested were a 0.5 wt% palladium-on-alumina catalyst and magnesium metal. Venting or purging successfully removed volatile chlorides. The fouling rates of coolants from various sources were significantly lowered by venting or purging and by exposure to palladium catalyst or magnesium. Author

N65-21797# Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
HEATS OF FORMATION OF GOETHITE, FERROUS VANADATE, AND MANGANESE MOLYBDATE
Ronald Barany 1965 14 p refs
(BM-RI-6618)

The heats of formation of goethite, ferrous vanadate, and manganese molybdate at 298.15° K were determined by solution calorimetry. For formation from the elements, the heat values were −133.7 ±0.3 kcal/mole for goethite, −453.8 ±0.5 kcal/mole for ferrous vanadate, and −284.8 ±0.2 kcal/mole for manganese molybdate. For formation from the oxides, the heat values were −0.9 ±0.1 kcal/mole for goethite, −19.4 ±0.3 kcal/mole for ferrous vanadate, and −14.6 ±0.1 kcal/mole for manganese molybdate. Author

N65-21799# Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN MIXTURES OF URANIUM AND MOLYBDENUM
A. D. Hues and A. L. Henicksman 27 Mar. 1965 22 p refs
(Contract W-7404-ENG-36)
(LA-3226) Available from AEC, Oak Ridge, Tenn.: $2.00

The spectrophotometric determination of uranium with 3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulfonic acid was modified and applied in the presence of large amounts of molybdenum, which is shown to be without effect. An extensive investigation was made of the interference of numerous foreign ions. The usual masking reagent is ethylenediaminetetraacetic acid. The use of sodium cyanide as a supplementary complexing agent was found to give significant improvement in the tolerance for cadmium, cobalt, copper, gold, iron, mercury, nickel, ruthenium, and zinc. The relative standard deviation of the procedure is shown to be less than 0.4% for a single determination. Author

N65-21807# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
CHEMICAL PROCESSING TECHNOLOGY Quarterly Progress Report, Jan.–Mar. 1964
J. R. Bower, ed. Jun. 1964 36 p refs
(Contract AT(10-1)-205)
(IDO-14638) CFSTI: $0.75

Dissolution of reactor fuel plates and processing of wastes is reported. Dissolution of Advanced Test Reactor fuel plates (core of 35% U_3O_8 in type X-8001 aluminum, clad in type 6061-0 aluminum) was found to proceed at a satisfactory rate in mercury-catalyzed nitric acid. Dissolution of advanced Pressurized Water Reactor fuel (zirconium oxide–uranium oxide wafers clad in zircaloy) was shown to be feasible in Monel equipment using a three-step process. Safe batch dissolution of Experimental Breeder Reactor-1 Core 3 fuel was demonstrated in nitric acid–hydrofluoric acid mixtures. Electrolytic dissolution of several plate- and tube-type stainless steel elements was also demonstrated with acceptably low corrosion rates for both the platinum anode and the niobium cathode. The waste calcining facility continued to operate smoothly, with two tanks of aluminum process waste being processed within acceptable radiation safety limits. Improvements to this facility and other plant projects are also reported. M.P.G.

N65-21817# Oak Ridge National Lab., Tenn.
REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING JANUARY 31, 1965
W. R. Grimes, E. G. Bohlmann, H. F. Mc Duffie, G. M. Watson, F. F. Blankenship et al Apr. 1965 375 p refs
(Contract W-7405-ENG-26)
(ORNL-3789) CFSTI: $7.00

The following were among the studies undertaken in the various program areas: *Molten-salt Reactors*—high-temperature phase equilibrium studies, radiation chemistry of the molten-salt reactor system, and chemical studies of molten salts; *Aqueous Reactors*—chemistry of pressurized-water reactor systems, corrosion studies for aqueous reactors and chemical processes, and mechanics of corrosion of zirconium alloys; *Gas-Cooled Reactors*—diffusion processes, reactions of graphite with oxidizing gases, and irradiation behavior of high-temperature fuel materials; *Nuclear Safety*—experiments with the containment mockup facility, behavior of fission products released during inpile simulated loss-of-coolant accidents, and release of fission products during melting of fuels under reactor transient conditions; and *Other Programs*—chemical support for saline water program, solvents for the fluoride volatility process, and effect of radiation on organic materials. G.G.

N65-21822# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

DEVELOPMENT OF SUBSTITUTE COMPOSITION FOR HIGH ALTITUDE FLASH SYSTEMS CONTAINING ELEMENTAL CALCIUM

Bossie Jackson, Jr., Seymour M. Kaye, and Garry Weingarten Jan. 1965 47 p refs

(PA-TR-3068; AD-454878)

The use of calcium fluoride additive in the 31/49/20 aluminum/potassium perchlorate/calcium fluoride blend yields a luminous efficiency of 8100 candle-seconds per gram at a reduced pressure of 20.9 mm Hg, which is far superior to standard flash compositions containing aluminum as the sole fuel, i.e., 40/60 aluminum/potassium perchlorate, 4800 candle-seconds per gram, and 40/30/30 aluminum/potassium perchlorate/barium nitrate, 5200 candle-seconds per gram. Although the calcium fluoride additive system does not equal the high-altitude performance of the FP-790 composition, 30/20/50 calcium/aluminum/potassium perchlorate, it does represent a good interim nonhygroscopic, readily procurable substitute for high-altitude flash systems containing elemental calcium. In tests conducted after a 24-hour water immersion and 136 hours of temperature cycling under high relative humidity conditions, the Poppy photoflash cartridge was observed to be a waterproof vehicle. The cartridges were sealed in accordance with standard procedure using a 70/30 Epon 828/Versamid 140 resin mixture and crimping both the delay holder and the cover in place using a 1.5-ton dead load. Author

N65-21848# Royal Aircraft Establishment, Farnborough (England).

THE FORMATION OF KETONES IN THE GAS PHASE OXIDATION OF n-HEPTANE IN THE LOW TEMPERATURE REGION [UBER DIE BILDUNG VON KETONEN BEI DER GASPHASENOXYDATION VON n-HEPTAN IM TIEFTEMPERATURGEBIET]

G. Ohlman, E. Schroder, and E. Leibnitz London, Min. of Aviation, Jan. 1965 11 p refs Transl. into ENGLISH from Chem. Ber. (Weinheim), v. 93, no. 11, 1960 p 2567–2572

(RAE-LIB-TRANS-1093)

It was demonstrated by gas chromatography that in the gas phase oxidation of n-heptane at 215° and 235° C considerable amounts of acetone, methyl ethyl ketone and methyl propyl ketone are formed. The slow oxidation leads to an excess of ketone in comparison to the higher aldehydes, while in the cool flame region the higher aldehydes outweigh the ketones. An attempt was made to give an explanation for the formation of the lower ketones from higher unbranched hydrocarbons. Author

N65-21895# Wayne State Univ., Detroit, Mich. Dept. of Chemistry

APPLICATION OF (dn/dc)–DATA FOR THE DETERMINATION OF PARTIAL SPECIFIC VOLUMES, FREE SOLUTE AND BULK VOLUMINA AND OF SOLUTE–SOLUTE AND SOLUTE–SOLVENT INTERACTIONS Interim Report

Wilfried Heller 22 Feb. 1965 36 p refs Submitted for Publication

(Contract Nonr-3511(00))

(TR-13(59); AD-460469)

The principles of a method are outlined for determining both the partial specific volume of a solute, $\bar{V}$, and its refractive index, n_2, by means of interferometric measurements of (dn/dc) using a suitable (dn/dc) expression in conjunction with both the one-component Clausius–Mosotti equation and a simple graphical interpolation procedure. The method, applicable if the polarizability of both solvent and solute molecules is unaffected by the solution process, is tested successfully on solutions of polystyrene in various solvents where the optical V-data agree to within better than 2% with densitometric $\bar{V}$-data given in the literature. It follows from the data that dissolved polystyrene contains up to 2% of free volume, the exact amount depending on both interaction parameters and on previously neglected steric factors. The variation, with temperature, of the free solute volume leads to the prediction of a molecular melting point and a molecular glass transition temperature for isotactic and branched chain polymers respectively dissolved in suitable solvents. Author

N65-21912# Central Lab. TNO, Delft (Netherlands).

THIN LAYER CHROMATOGRAPHY OF POLYPHENYLS ON BENTONE

F. J. Ritter, G. M. Meyer, and F. Geiss (EURATOM) Brussels, EURATOM, Dec. 1964 14 p refs in DUTCH; ENGLISH summary Presented at the Symp. on Chromatography, Brussels, 14–15 Sep. 1964

(Contract EURATOM-096-63-1 ORGN)

(EUR-2191.n) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

For coating plates it is necessary to add celite to bentone. Chromatography was studied at biphenyl, 3 terphenyls, 9 quaterphenyls, some quinquiphenyls, anthracene, phenanthrene and triphenylene whereby n-heptane is used as solvent. By repeated treatment the separation is improved and after three runs reaches its optimum. After comparing these results with the more classical materials like aluminium oxide it seems that the rf-values on bentone depend more upon structure (ortho, meta and para) and less upon molecular weight. Phenanthrene which gives trouble at the quantitative determination of terphenyls on aluminium oxide can very well be separated on bentone 38. Chromatography on bentone 38 may be regarded as a good supplementary method to that on alumina. Author

N65-21925# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research

METHODS FOR DETERMINING OF TRACE AMOUNTS OF IRON, ALUMINUM AND SILICIC ACID IN THE REACTOR WATER OF THE PRIMARY CIRCUIT [METODY OPREDELENIYA SLEDOVYKH KOLICHESTV ZHELEZA, ALYUMINIYA I OKISI KREMNIYA V VODE PERVOGO KONTURA YADERNYKH REAKTOROV]

T. Novicka-Yankovska and A. Golkovska [1964] 19 p refs In RUSSIAN; ENGLISH summary

(Rept.-590/VIII)

The problem of determination of silica in water is discussed. The results of the determination of silica in the reactor water are shown. Silicon was determined by the molybdenum blue method. The water samples were prepared by various procedures. Statistic calculations were performed for the comparison of the used procedures. Two methods of the determination of iron are discussed. Iron was determined as complex with 2,2'-dipyridyl or with 4,7-diphenyl-1,10-phenanthroline. The results obtained by these methods are shown. Hematoxylin was used as reagent for aluminum. The results of the determination of aluminum in the reactor coolant water are shown. Author

N65-21934# Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.

HEATS OF FORMATION OF ANHYDROUS SULFATES OF CADMIUM, COBALT, COPPER, NICKEL, AND ZINC

L. H. Adami and E. G. King 1965 14 p refs
(BM-RI-6617)

The heats of formation of anhydrous cabmium sulfate, cobalt sulfate, copper sulfate, nickel sulfate, and zinc sulfate were determined by hydrochloric acid solution calorimetry. The values at 298.15° K for formation from the metal, rhombic sulfur, and oxygen gas follow (cal/mole)—$CdSO_4$, −222.0 ±0.3; $CoSO_4$, −212.0 ±0.4; $CuSO_4$, −183.4 ±0.6; $NiSO_4$, −208.1 ±0.2; and $ZnSO_4$, −233.0 ±0.2. Corresponding heats of decomposition to form the metal oxide, sulfur dioxide, and oxygen were derived from these results; heats of decomposition to form the metal oxide and sulfur trioxide were also derived. Author

N65-21941 United Kingdom Atomic Energy Authority, Harwell (England).
FURTHER STUDIES OF THE RADIOLYTIC EXCHANGE OF CARBON-14 BETWEEN CARBON MONOXIDE AND CARBON DIOXIDE
D. A. Dominey, T. F. Palmer, and J. C. Robertson 1964 14 p refs
(AERE-R-4481)

The rate of exchange of carbon-14 between ^{14}CO and CO_2 in a γ-flux was shown to be independent of temperature between 30° and 300° C. Experiments in which mixtures of ^{14}CO, CO_2 and O_2 were irradiated in BEPO have confirmed that both $G(^{14}CO_2)$ and $G(-O_2)$ are independent of oxygen concentration in the range studied, but $G(^{14}CO_2)$ is higher than for pure $^{14}CO/CO_2$ mixtures. The dose necessary for complete consumption of O_2 can be calculated by extrapolation. For irradiation doses larger than this the $G(^{14}CO_2)$ is the same as previously reported for mixtures of ^{14}CO and CO_2 alone. Nitric oxide inhibits the exchange reaction. The overall mechanism of the reaction in the presence of NO cannot be explained in terms of reactions involving oxygen atoms. This agrees with the previous conclusion based on the results of experiments in which the exchange reaction was studied in the presence of NO_2 or O_2. The result of one experiment indicates that krypton has little effect on $G(^{14}CO_2)$. However, the addition of xenon appears to increase $G(^{14}CO_2)$ when the latter is calculated on the basis of energy absorbed in CO_2 alone. Author

N65-21945 United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
LIGHT INDUCED CHEMILUMINESCENCE
T. J. Kemp and C. G. Clayton Sep. 1964 35 p refs
(AERE-R-4737) HMSO: 5s

The hypothesis that spurious luminescence in dioxan-based liquid scintillators arises from photochemically induced decomposition of peroxidic impurities was examined by observing other organic liquids containing peroxide impurities, solutions of hydroperoxides, and solutions of unstable azo-compounds. The results indicate that all these systems show very similar behavior with regard to the intensity, duration, and mode of decay of the luminescence, and that the effect of oxygen increases the period of luminescence in all cases. By studying the photo-induced decomposition of azo-bis-isobutyronitrile in benzene under conditions of nitrogen saturation it is concluded that in this type of process the oxygen molecule cannot be considered to be associated with the fluorescence mechanism as in the case of thermally decomposing hydroperoxides. It is suggested that the observed luminescence may be related to that which occurs in several other processes, such as the electrolysis of amino and carboxylic acids and the dissolution of X-irradiated organic and inorganic compounds. Author

N65-21949 United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
HANDLING RADIOACTIVE SAMPLES FOR MASS SPECTROMETRIC ANALYSIS
A. H. Turnbull Nov. 1964 14 p refs
(AERE-R-4774)

A technique is described for mounting radioactive samples and introducing them into the ion source of an A.E.I. Type MS5 surface ionization mass spectrometer. Author

N65-21951 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
REACTION OF ALUMINA WITH CESIUM VAPOUR
J. K. Higgins Nov. 1964 26 p refs
(AERE-R-4781)

The attack of cesium vapor on high purity single and polycrystalline alumina and on material containing added impurities—Cr_2O_3, TiO_2 and NiO—has been studied at 600° C. In general the more porous sintered aluminas react more rapidly than the single crystals and the low porosity Lucalox-type materials. Neutron irradiation increases the attack in all cases causing deep cesium penetration of the high porosity samples. The pitting attack observed on the single crystals is thought to be due to the presence of localized silicon and barium impurities and the increased reaction and penetration of the high porosity polycrystalline materials to be caused by microcracking resulting from radiation-induced lattice expansion. Author

N65-21953 United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
RAPID METHODS FOR DETERMINING THE RELATIVE AMOUNTS OF ZIRCONIUM^{95} AND NIOBIUM^{95} BASED ON ANION-EXCHANGE PAPER CHROMATOGRAPHY AND GAMMA-SPECTROMETRY
C. J. Hardy and C. E. Lyon Dec. 1964 11 p refs
(AERE-R-4814) HMSO: 1s 9d

The γ-activities of Zr^{95} and Nb^{95} relative to each other can be obtained rapidly by separation of the two radionuclides by anion exchange paper chromatography in a HCl–HF medium followed by γ-counting sections of the paper (γ-spectrometry is necessary if other γ-emitting nuclides are present), and by measurement of the mean γ-energy, or width, of the composite γ-photopeak at about 760 KeV with a multichannel γ-spectrometer. The chromatographic method is an improvement on previous chromatographic and standard radiochemical methods for these radionuclides and is applicable to their solutions in various mineral acids and organic solvents. The composite γ-photopeak method is more rapid but less accurate than the chromatographic method, particularly at low percentages of Nb^{95}. Author

N65-21954 United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE. PART IV: GAS FLOW EXPERIMENTS IN DIDO. THE EFFECT OF METHANE
D. A. Dominey and H. Morley Dec. 1964 36 p refs
(AERE-R-4817, Pt. IV) HMSO: 3s

The inreactor apparatus consists of a calorimeter and two stainless steel capsules containing graphite samples, one of which is labelled with ^{14}C. The capsules are supplied with independent capillary leads to in-line analytical apparatus consisting of a scintillation counter, a water meter, an I.R.G.A. and an automatic sampling gas chromatograph which also

records the ^{14}C content of each component of the gas. The rate of ^{14}C evolution in pure CO_2 has been compared with that in mixtures of CO_2 with 1% CO and up to 0.2% CH_4, and the effects of variation of flow rate, dose rate, temperature and pressure on the reduction of oxidation rate have been studied. The results suggest that the agent responsible for protecting the graphite from oxidation is a short-lived product of the radiolysis of $CO–CO_2–CH_4$ mixtures and that this agent interferes in some way with processes occurring at the graphite surface. An experiment using $^{14}CH_4$ showed that carbon which is deposited in some form during the period in which oxidation was reduced was slowly removed while the normal oxidation rate in CO_2 was being reestablished. Author

N65-21999# Esso Research and Engineering Co., Baytown, Tex.
REACTIONS OF GASEOUS IONS. XV: CH_4 + 1% C_2H_6 AND CH_4 + 1% C_3H_8
M. S. B. Munson and F. H. Field Mar. 1965 30 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-11-P; AD-460838)

Mass spectrometric studies have been made of gaseous ionic reactions in mixtures of CH_4 + 1% C_2H_6 and CH_4 + 1% C_3H_8 at pressures up to 2 torr. The ionic distribution at high pressures is very different from that in pure CH_4. Both dissociative and nondissociative proton transfer reactions are observed between CH_5^+ and C_2H_6 to give $C_2H_5^+$ and $C_2H_7^+$ in a ratio of 3 or 4 to 1. The proton affinity of ethane is therefore greater than the proton affinity of methane. From the formation of CH_5^+ in pure CH_4 and the dissociative proton transfer reaction in CH_4 + 1% C_2H_6 upper and lower limits for the proton affinity of methane can be determined, $115 \leq P(CH_4) \leq 121$ kcal/mole. Formation of $C_3H_9^+$ from proton transfer of CH_5^+ to C_3H_8 occurs to a very small extent, if at all; dissociative proton transfer to give both $C_3H_7^+$ and $C_2H_5^+$ was observed, however. The nonreactivity of certain ions was established; these nonreactive ions illustrate the necessity for chemical considerations in discussing ionic reactions. Author

N65-22009# Aeronutronic, Newport Beach, Calif. Chemistry Lab.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Seventh Quarterly Technical Report, 1 Sep.–30 Nov. 1964
D. L. Hildenbrand, L. P. Theard, and F. Ju 1 Jan. 1965 8 p refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(U-2969; AFRPL-TR-65-17; AD-455379)

Spectrographic analysis of 99.9% pure beryllium samples heated in tantalum and tungsten effusion cells to temperatures in the range 1400° to 1500° K yielded a heat of sublimation value for beryllium of 77.3 ±0.1 kcal/mole, with absolute uncertainty less than 0.4 kcal/mole. Vapor equilibria were studied in the Be + CaF_2 and Be + BF_3 systems heated to 1300° to 1600° K in beryllia effusion cells; equilibria constants and third-law heat values are presented, as derived from mass spectrometer analysis of the experimental data. A value of 5.86 ±0.1 eV was found for the thermochemical dissociation energy of BeF, which establishes that the dissociation products of the $X^2\Sigma$ state are $Be(^1S) + F(^2p)$, while those of the $A^2\pi$ state are $Be(^3p) + F(^2p)$. Study of the vaporization of beryllium oxide by the torsion-effusion method is discussed briefly. J.M.D.

N65-22020# Illinois Univ., Urbana. Noyes Chemical Lab.
FLUORINE NMR SPECTRA AND CONFORMATIONAL ISOMERIZATION OF 1,1-DIFLUOROCYCLOHEXANE
J. Jonas, Adam Allerhand, and H. S. Gutowsky 5 Jan. 1965 18 p refs Submitted for Publication
(Contract Nonr-1834(13))
(TR-80; AD-457508)

The F^{19} high resolution spectrum of 1,1-difluorocyclohexane has been observed at temperatures from −93° to +40° C. The rate of conformational isomerization was determined by a complete line shape analysis method for temperatures from −71° to +6° C. The activation parameters $\Delta H^{\neq}$ and $\Delta G^{\neq}_{cc}$ in kcal/mole and $\Delta S^{\neq}_{cc}$ in eu were found to be 9.0, 9.8, −3.3 and 8.6, 9.8, −5.0 for 1:1 v/v solutions in CS_2 and $CFCl_3$, respectively, at the coalescence temperature of 228° K. In the low temperature spectra of the CS_2 solution, the resonance of the equatorial fluorine is shifted 15.64 ppm downfield from the axial and J_{FF} is 235.2 cps; also, $J(H_{ax}–F_{ax})$ the axial–axial vicinal H-F coupling constant is 34.3 cps and $J(H_{eq}–F_{ax})$ is 11.5 cps. At temperatures above −10° C, neglect of the H–F coupling in the line shape analysis produces systematic errors in the apparent exchange rate. Author

N65-22022# Melpar, Inc., Falls Church, Va.
RESEARCH ON PHOTOTROPIC BEHAVIOR OF MATERIALS FOR FLASH BLINDNESS PROTECTION First Triannual Report
Nov. 1964 40 p refs
(Contract DA-19-129-AMC-389(N))
(AD-457621)

Several thiazine derivatives, two xanthine derivatives, and napthol yellow S and the applicable leuco derivatives were investigated spectrophotometrically over the range from 360μ to 800μ. Leuco compounds of methylene blue, methylene green, azure A, azure B, and azure C formed leuco compounds which were stabilized against dark oxidation to the colored form by 2-mercaptoethanol. A flash of light, with the necessary condition of the presence of oxygen, converts the leuco forms of these dyes to the deeply colored species. This reaction is completely reversible in 2-mercaptoethanol (aqueous) solution. Photo-oxidation does not occur in the absence of oxygen. In the absence of 2-mercaptoethanol the photo-oxidation is not reversible. Chromatographic fractionation procedures for preparing small quantities of the components of commercial samples of the various dyes are described. Absorption spectra are presented. Author

N65-22023# United States Rubber Co., Wayne, N. J. Research and Development Dept.
BONDING CELLULOSE ESTERS TO ELASTOMERS Progress Report, Jul.–Sep. 1964
C. H. Stiteler and D. L. Relyea 28 Oct. 1964 5 p Prepared for Hercules Powder Co.
(Rept.-195-64-3; AD-457865)

Recent results are described in a program designed to promote adhesion of silica-filled SBR to nitrocellulose by formation of chemical bonds between the two materials. The ABL Spec. 123 motor case liner was shown to adhere to nitrocellulose much better when stearic acid is omitted from the rubber stock. Arylmaleimide-MBTS cured stocks show intermediate adhesion values independent of stearic acid presence. Studies of the chemical modification of nitrocellulose with FRO (N-carbamylmaleimide) and zinc chloride in acetonitrile at 75° showed degradation of the nitrocellulose. Solutions of nitrocellulose or cellulose acetate in dimethylformamide were gelled by 4,4'-methylenebis(phenylisocyanate) (MDI) in 1 hour at 75° C. Author

N65-22032# New York Univ., N. Y. Dept. of Chemistry
THE ANODIC REACTION MECHANISM IN FUSED SILVER NITRATE Technical Progress Report
Nirmal Gupta and Benson R. Sundheim 16 Feb. 1965 27 p refs Presented at the Symp. on Fused Salts at the meeting of the Electrochem. Soc., San Francisco, 9–14 May 1965
(Contract Nonr-285-37)
(AD-611848)

The oxidation of the nitrate ion at a Pt anode in molten $AgNO_3$ has been studied by steady-state and fast sweep voltammetry. Two mechanisms are found, both leading to $NO_2 + 1/2\ O_2$. The first is susceptible to transport control and has an $n\alpha$ value of 1.17 at 238°C. It is postulated that this mechanism involves the preliminary dissociation of the nitrate ion to form $NO_2^+ + O_2^=$, the latter (possibly bound as orthonitrate) being the electroactive species. The second mechanism is not subject to transport control and has an $n\alpha$ value of 0.90. This is thought to involve the formation of NO_3 radical followed by its decomposition to form the products. If the E_o values of 0.357V and 1.25V are adopted, the two mechanisms are characterized by exchange current densities of 2.4×10^{-3} amp/cm^2 and 0.19 amp/cm^2, respectively. The corresponding values calculated for k_o, the heterogeneous rate constant, are 1.3×10^{-7} and 1.1×10^{-7} cm/sec. Author

N65-22038# National Bureau of Standards, Washington, D. C. Electrolysis and Metal Deposition Section
DEPOSITION OF TUNGSTEN BY REDUCTION OF THE HEXAFLUORIDE WITH HYDROGEN IN THE VAPOR PHASE Quarterly Progress Report, 1 Aug.–1 Nov. 1964
Jean H. Connor and Abner Brenner 20 Nov. 1964 3 p
(Contract AF 33(615)64-1004)
(AD-461031)

An investigation of tungsten deposition by reduction of hexafluoride with hydrogen in the vapor phase emphasizing the effect of hydrogen chloride on metallic deposition is presented. Also presented are determined values for resistivity, tensile strength, and stress of vapor deposited tungsten as well as plating rates at different temperatures over a range of gas compositions. Regardless of gas mixture composition, the rate of plating depended on the amount of tungsten already plated from the mixture. The more hexafluoride produced, the more diminished the plating rate in the static system. Evidence of an inhibiting hexafluoride reaction with tungsten hexafluoride during plating of a series of deposits from a gas mixture led to an attempt to remove hexafluoride from the mixture by reacting it with tungsten hexachloride. Attempts to plate from the resulting mixture at 700 degrees Centigrade produced very stressed, unsatisfactory metal, indicating that hydrogen chloride or a side product had a deleterious effect when present in large quantities. Further experimentation using varying amounts of hydrogen chloride gas at varying temperatures yielded heavier metallic deposits. S.C.W.

N65-22039# IIT Research Inst., Chicago, Ill. Technology Center
RESEARCH ON CHEMISTRY OF O_3F_2 AND O_2F_2 Technical Summary Report No. 9, 1 Jul.–30 Sep. 1964
Irvine J. Solomon 31 Oct. 1964 33 p
(Contract AF 49(638)-1175; ARPA Order 350-62)
(IITRI-C227-9; AD-451137)

The elucidation of the chemistry of O_3F_2 and O_2F_2 with inorganic compounds, studies of the physical properties of O_4F_2 as a means of revealing the presence or absence of ionic species in O_4F_2, and the determination of the feasibility of preparing new ions of the type NF_4 and $NH_2F_2^+$ are presented. The explosive reaction of SO_3 and O_2F_2 was moderated by using F_2SO_2 or a solvent. The reaction of H_2SO_5 with O_2F_2 indicates that H_2SO_5 is easily fluorinated. The vigorous reaction of SO_2 and O_2F_2 produced F_2SO_2 and some interesting OF- and OOF-containing compounds. The O_3F_2–$NaNO_2$ and O_3F_2–NaOH systems produced very little reaction. Sulfur reacted vigorously with O_3F_2. In attempts to detect the formation of ionic species such as NF_4^+ and $N_2F_5^+$, $(CH_3)_3Al$ was dissolved in liquid isopentane (CaH_2-dried), HNF_2 was condensed above the solution, and CH_4 evolution was measured. Pressure–composition diagrams were obtained for the CF_3CO_2H–HNF_2 system at −63.5° and −45.2° C. Both diagrams are typical of a system composed of a solid of low volatility which is partly soluble in a volatile liquid and forms a nearly ideal solution with it. The $(CF_3CO_2)O$–HNF_2 system components are miscible in all proportions with no significant interaction. A phase-diagram study was conducted on the CH_3NF_2–SO_3 system at −63° to −65° C. Indirect determination of fluorides by the EDTA titration of samarium is presented in the appendix. R.W.H.

N65-22043# Emmanual Coll., Boston, Mass. Research Language Center
SPINEL PRODUCED BY SINTERING REACTION BETWEEN BASIC OXIDES AND ALUMINA
Goro Yamaguchi Bedford, Mass., AFCRL, Aug. 1964 14 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 61, no. 690, 1953 p 594–599
(E-T-J-64-9; AD-456753)

Sintering products of perfect and imperfect spinel compounds produced by reacting basic oxides with alumina were studied by X-ray analysis and classified according to sintering temperature, relative intensity of spinel line, lattice constant, crystalline grade, and color, for comparative purposes. Imperfect spinels are also classified according to their degree of imperfection. A study of thermal transformation of gamma-alumina into a-alumina was conducted to determine whether the gamma → a transformation is a one-way reaction from the unstable form gamma to the stable form a. Equations were derived in support of this study. Investigations of several groups of basic oxides are treated as separate entities. S.C.W.

N65-22046# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
VAPOR LUBRICATION OF HIGH SPEED BALL BEARINGS
Leon Stallings 4 Jan. 1965 8 p
(NAEC-AML-2107; AD-457104)

The lubricant properties of reaction products resulting from the interaction of vapors generated by volatile compounds and the constituents of the metal bearing surfaces were investigated. Vapor lubrication phenomena studied were decomposition of vapor at elevated temperature yielding a liquid fraction; formation of solids produced by chemical reaction between metal and vapor; and physical adsorption of vapors on metal surfaces. Volatile compounds investigated were amine dithiocarbamates, chlorinated aromatic amines, and bromocamphor. Results of additional studies on the effect of carrier gas properties on vapor lubrication are also presented. Tables are included which show the lubricant performance properties of 14 different organic compounds using nitrogen carrier gas. Chromium alloy bearings having carbon steel retainer components served as test specimens. S.C.W.

N65-22079# Naval Research Lab., Washington, D. C. Chemistry Div.
PHOTODEGRADATION OF HIGH POLYMERS. PART V: PHOTOLYSIS OF POLY(ALKYLENE POLYSULFIDES) IN VACUUM
L. G. Isaacs and R. B. Fox 4 Feb. 1965 18 p refs
(NRL-6202; AD-612425) CFSTI: $0.50

The rates of weight loss of several polyalkylene polysulfides during exposure to a simulated space environment were measured and compared to the rates of weight loss of several nonsulfur containing polymers. The products of degradation of polymethylene disulfide and tetrasulfide and polyethylene disulfide and tetrasulfide were identified and gaseous products were quantitatively measured. The major products of degradation were hydrogen sulfide, carbon monosulfide (which polymerizes on surfaces within the exposure cell), and, for the methylene polymers, carbon disulfide. The tetrasulfide polymers deposited a rubbery film on the walls of the exposure cell which was spectroscopically identical to exposed polyalkylene tetrasulfide. A mechanism of degradation compatible with these results is suggested. Author

N65-22090# Tufts Univ., Medford, Mass. Dept. of Chemistry
A STUDY OF HYDROGENOLYTIC DESULFURIZATION BY MEANS OF HYDRAZINE Combined Progress Reports Nos. 1–4, 1 Oct. 1962–30 Sep. 1964
Vlasios Georgian [1964] 6 p ref
(Contract DA-ARO-D-31-124-G262)
(AD-612279) CFSTI: HC $1.00/MF $0.50

Based on an analysis of the interaction between convective heat transfer and atmospheric stratification, this paper preliminarily establishes a model of convective heat transfer, and numerical computation is given. The results of the computation show that the interaction between heat transfer and atmospheric stratification plays an important role in heat transfer. Heat flux is much greater during unstable stratification than during stable stratification. As a consequence of the vertical transfer of heat flux, atmospheric stratification clearly changes in the initial stage, while in the final stage, it approximates neutral stratification. Author

N65-22133*# Purdue Univ., Lafayette, Ind.
THE ARC SPECTRUM OF TIN
Wilfred Grenfell Brill (Ph.D. Thesis) Jan. 1964 26 p refs
(NASA-CR-62284) CFSTI: HC $4.00/MF $1.00

The arc spectrum of tin has been investigated photographically using plane- and concave-grating spectrographs and Fabry–Perot interferometers crossed with a plane grating spectrograph and with a quartz prism spectrograph. The light sources employed were electrodeless discharge tubes containing tin halides. In the wavelength region investigated, 376 lines were measured; 141 are new, and 314 were measured interferometrically. An analysis of the arc spectrum of tin has been carried out with the result that 329 of the lines are now classified and 38 new energy levels have been found, bringing the total number of even levels to 62 and of odd to 138. Two lines were found to be due to forbidden transitions between levels of the same parity. In addition, 42 lines belonging to the first spark spectrum of tin were measured and one new even energy level for this spectrum was found. Author

N65-22143# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry
STRUCTURE AND PROPERTIES OF MOLTEN SALTS Final Report
George J. Janz Dec. 1964 11 p refs
(Grant AF-AFOSR-181-63)
(AFOSR-65-0244; AD-611164)

A summary is given of physicochemical studies which resulted in new insights into the chemical and structural nature of molten inorganic salts. For the purpose of providing a guide to the selection of molten salts for particular applications or structural studies, a classification scheme is proposed (based on the energies of activation) for viscous flow and electrical conductance. TAB

N65-22144# Naval Research Lab., Washington, D. C. Chemistry Div.
SYNTHESIS, CHARACTERIZATION, AND ESTER–ESTER INTERCHANGE STUDY OF THE MIXED ESTER 2-ETHYLHEXYL BENZYL AZELATE
Jacques G. O'Rear and Paul J. Sniegoski 8 Jan. 1965 12 p refs
(NRL-6149; AD-612092) CFSTI: $0.50

New components are in demand for low-temperature instrument oils. To meet this demand two new esters, bis (3,4-dichlorobenzyl)beta-methyladipate and 2-ethylhexyl benzyl azelate, were synthesized and although both esters possessed the required high surface tensions (43.6 and 33.4 dynes/cm at 20° C, respectively); only the azelate had a suitable viscosity for low-temperature application. This mixed ester, 2-ethylhexyl benzyl azelate, was prepared by the esterification of the half ester, 2-ethylhexyl hydrogen azelate, with a large excess of benzyl alcohol. A study was made of the disproportionation of 2-ethylhexyl benzyl azelate into two symmetrical diesters: 2(2-ethylhexyl benzyl azelate) reversibly yields dibenzyl azelate + bis(2-ethylhexyl)azelate. The reaction rates for this ester-ester interchange were found to be too small to restrict the desired application of the mixed ester at temperatures below 100° C. Author

N65-22149# Naval Research Lab., Washington, D. C. Chemistry Div.
STABILIZATION OF SILICONE LUBRICATING FLUIDS AT 300° TO 400°C BY SOLUBLE CERIUM COMPLEXES
H. R. Baker, J. G. O'Rear, P. J. Sniegoski, and R. E. Kagarise 8 Jan. 1965 23 p refs
(NRL-6156; AD-612064)

The Si-H bond was shown to be involved in the formation of a stable cerium-silicone inhibitor system and this discovery was applied to the development of improved methods for stabilizing silicones. The inhibitory process uses initial reactions between hydrous cerous acetylacetonate and a polymethylhydrogen silicone. These reactions proceed and terminate in aerated refluxing benzene to provide a silicone-soluble adduct. The chemistry of the hydride group was followed quantitatively and some features of structure are postulated for the adduct. The simplified inhibitory process is a two-step reaction. Stabilization is completed by aerating a mixture of the cerium adduct and a silicone oil for one hour at 270° to 280° C. There is an optimum concentration of cerium adduct for the stabilization of lightly phenylated dimethyl silicones. The same concentration achieves 100 to 500 percent improvements in the 300° C stability of dimethyl silicones and their chlorophenyl- and phenyl-substituted types; with more highly phenyl-substituted silicones, stabilization temperatures are raised to 400° C and relative improvement factors roughly parallel those observed at 300° C. Author

N65-22155# Kansas State Univ., Manhattan.
SENSITIZED FLUORESCENCE Third Semiannual Technical Summary Report, 1 Jul.–31 Dec. 1964

Basil Curnutte, Jr. [1964] 7 p
(Contract Nonr-3634(02); ARPA Order 306-62; Proj. Defender)
(AD-611756)

Another technique for the determination of the total quenching cross section of thallium on mercury fluorescence is described. Results from a single run using this method are compared to previously described results. The procedure for determining the total quenching cross section is: (A) From the absorption data on the mercury only cell and a mercury-thallium cell at the same temperature determine the mercury number density in the mercury thallium cell. (B) From the number density of mercury atoms in the cell and the data on the mercury only cell determine the expected scattering, I, at each temperature. (C) Correction for slight changes in geometry between the cells and correction for the transmission of the windows will be a simple multiplicative constant which can be determined at low temperatures, where there is not enough thallium vapor to give any appreciable quenching; thus the scattering I can be determined. Author

N65-22175*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON DIFFRACTION ANALYSIS OF MIXTURES OF HEXAGONAL AND CUBIC CdS
Norman Tideswell 28 May 1964 6 p refs Submitted for Publication
(NASA-TM-X-51777) CFSTI: HC $1.00/MF $0.50

Estimation of hexagonal cadmium sulfide in mixtures with the cubic form can be obtained by reflection electron diffraction of the polycrystalline material. Photographic plates are microphotometered and the integrated intensities are measured for several lines. Intensity ratios for the sample are compared to similar data for calibration standards and the hexagonal content is obtained graphically. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-21170# Air Force Cambridge Research Labs., Bedford Mass. Data Sciences Lab.
SOLVING THE WIENER–HOPF EQUATION
David A. Shnidman Jan. 1965 32 p refs *Its* Phys. and Math. Sci. Res. Papers No. 74
(AFCRL-65-44; AD-612693)

The Wiener–Hopf equation is briefly derived, and the method of solving is presented. The solution is then specialized for the case where the message and input spectral densities, $\Phi_{mm}(\lambda)$ and $\Phi_{ii}(\lambda)$, respectively, are rational functions. Author

N65-21195# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DYNAMIC-RANGE REDUCTION OF VIDEO SIGNALS BY AMPLITUDE COMPRESSION
R. D. Behn 16 Nov. 1964 29 p *Its* Group Report 1964-59
(AD-609361)

Methods of recording a video signal with large dynamic range on a magnetic tape (or other recording medium) that has a smaller dynamic range than that of the signal are discussed. The useful part of the voltage range of the input signal is mapped onto the linear voltage range of the recorder. Several maps are considered with the thought of minimizing the degradation of the final signal by recorder noise. Two mapping functions are found to be useful: a logarithmic function, and a part-linear, part-logarithmic one. The use of these maps entails a reduction in signal-to-noise ratio for large input signals. The relationships among the input signal dynamic range, the recorder dynamic range, and the attainable output signal-to-noise ratios are calculated. Results are presented graphically for several particular cases. Author

N65-21203# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
RELIABILITY IMPLEMENTATION IN ONE ELECTRONIC SYSTEM
Richard E. Worthey (M.S. Thesis) Nov. 1964 99 p refs
(GRE/SM/64-4; AD-609933)

The reliability program for the radio set AN/ARC-34 is analyzed. Failure distribution model and reliability function derived for each subsystem show that the distribution of failures is exponential. The areas of reliability organizations, reliability reports, and procurement documents are analyzed. An analysis made of the reliability requirements shows that the present requirements do not insure an operationally reliable system. Author

N65-21207# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CARRYING CAPACITY OF A MULTITRACK SYSTEM
I. A. Ovseyevich 25 Jan. 1965 23 p refs Transl. into ENGLISH from Problemy Peredachi Inform. (Moscow), no. 14, 1963 p 43–58
(FTD-MT-64-394; AD-612374)

The carrying capacity of a multitrack system is calculated by considering the mechanism of forming the output signal in each channel as similar to multibeam propagation of short radio waves. Fading and independent noises in the general case are also considered. Equations on speed of transmission of information, Rayleigh fading, gaussian fading, and carrying capacity are calculated, and a numerical example is given. L.S.

N65-21242# Weapons Research Establishment (Australia). Dept. of Supply
AN EXTENSION OF THE RESULTS OBTAINED BY THE APPLICATION OF THE NUMERICAL SOLUTION OF LAPLACE'S EQUATION TO TRANSMISSION LINE PROBLEMS
H. E. Green Feb. 1965 23 p refs
(PAD-98)

In this paper a method developed previously for the solution of Laplace's equation by finite differences is applied to the problems of determining the equivalent circuit of a series gap in the inner conductor of a coaxial line and of computing characteristic impedance and velocity ratio of microstrip transmission line. An extension to the theory of compensated bead supports in coaxial line is also made. Author

N65-21267# Cubic Corp., San Diego, Calif.
VIRGO DATA LINK FOR PROJECT SEE FAST. PRESENT AND FUTURE CAPABILITIES Technical Memorandum No. 29
22 May 1964 31 p ref
(Q-8871)

A review of the VIRGO (video information relay to ground outpost) equipment capabilities and growth potential is given. This system is intended to provide a real-time data link by which reconnaissance data may be transferred from an aircraft over a battle area to a command post. The information from several types of sensors in either of two aircraft is frequency modulated on three channels in the C-band of the rf spectrum, transmitted to a relay aircraft, and processed on three other carriers for transmission to the ground station. This system has the following features: high data rates, antijamming feature, flexibility, low-noise operation, modular construction, solid-state circuit design, mobility, and rapid delivery. Growth features include higher gain antennas, miniaturization of the receivers, preprocessing of the data, higher power transmitters, fm feedback, and lower-noise preamplifiers. G.G.

N65-21270# Federal Aviation Agency, Washington, D. C.
NAS EN ROUTE RADAR DATA PROCESSING AND DISPLAY CONFIGURATION
Neal Blake Mar. 1965 9 p *Its* National Aviation System Design Note No. 2

Data processing and display system configurations for implementing NAS Stage A En Route centers are described. The first system presented is based on the use of a CDC type of alphanumeric generator which presents all data to the displays through a single channel. The second system uses existing equipment modified only to the extent necessary to add alphanumerics to a display of radar position data. A digital mosaic generator is used in both configurations and permits the definition of sector areas independent of single radar siting. G.G.

N65-21294# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF AUGUST 1964
[1964] 23 p

Optical observation data of satellites in Europe are presented, including unidentified objects from the years 1960 through 1964. The 1960 iota 1 (Echo 1) data were excluded. G.G.

N65-21295# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF SEPTEMBER 1964
[1964] 25 p

Optical-observation data of satellites in Europe include lists of unidentified objects from the years 1960 through 1964. The 1960 iota (Echo 1) was excluded and only one observation per transit for the 1964-04A (Echo 2) was made. G.G.

N65-21296# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FOR THE MONTH OF OCTOBER 1964
[1964] 19 p

Optical observation data of satellites in Europe are presented in tabular form and cover the years 1960 through 1964. The 1960 iota (Echo 1) and the 1964-04A (Echo 2) are not included. G.G.

N65-21318*# Alaska Univ., College. Geophysical Inst.
ABERRATIONS OF RADIO SIGNALS TRAVERSING THE AURORAL IONOSPHERE Interim Report No. 1, 1 Aug. 1964–31 Jan. 1965
Edward J. Premouw [1965] 33 p refs
(Contract NAS5-3940)
(NASA-CR-57942) CFSTI: HC $2.00/MF $0.50

Satellite tracking and data acquisition records from the NASA facility near Fairbanks are being directly compared with radio-star wavefront signal measurements monitored beneath the auroral ionosphere to evaluate auroral ionospheric effects. Although no appreciable attenuation due to ionospheric absorption of satellite signals traversing the auroral zones and received by the 85-ft antenna on 136 Mc/s, 400 Mc/s, and 1700 Mc/s is expected, fluctuations in received signal strength occur due to ionospheric scattering of the signal. The occurrence frequency of scattering effects is a strong function of the solar activity cycle, also exhibiting diurnal and seasonal variations. Typically these fluctuations measured less than 3 decibels, peak to peak, but on at least two occasions reached 20 decibels. It was also found that ionospheric scattering produces fluctuations in the apparent arrival direction of the signal. From observations on the lowest observing frequency, 68 Mc/s, there is evidence of multiple-scaled ionospheric structure. A majority of the records, however, seem to show a preponderance of single-scale effects. L.S.

N65-21495# Michigan Univ., Ann Arbor. Radiation Lab.
IONOSPHERIC DISTURBANCES AND THEIR EFFECTS ON THE PROPAGATION OF HF ELECTROMAGNETIC WAVES Final Report, Jun. 1960–Jun. 1964
Chaio-Min Chu, Gunnar Hok, and John J. LaRue Sep. 1964 128 p refs
(Contract AF 19(604)-7257)
(Rept.-3673-1-F; AFCRL-64-916; AD-609085)

This report is concerned with the effect of ionospheric disturbances on high-frequency radio waves whose propagation path is at a large distance from the source of the disturbance. The perturbation of the high-frequency radio waves is assumed to be due to mechanical waves propagating in the atmosphere. The macroscopic equations governing the propagation of mechanical waves in the atmosphere, including the effects of viscosity and thermal conductivity, are developed. A simple model of the atmosphere is proposed, and a technique, suitable for numerical analysis, is developed for determining the various modes propagating. The effect of the earth's magnetic field on the propagation of mechanical waves is evaluated, and it is concluded that this effect is small. The modification of the disturbance due to the presence of charged particles is discussed in conjunction with a comparison of the microscopic and macroscopic formulation of the equations of motion. An idealized description of the source is given, and some solutions to some simple problems are discussed. Author

N65-21503# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
DESIGN AND CONSTRUCTION OF A BAND-PASSED MATCHED FILTER Technical Report No. 84
S. Rashba Dec. 1964 62 p refs
(Contract DA-36-039-AMC-00034(E))
(EERL-31; AD-610306)

A bandpassed matched filter and coded-pulse generator was designed and constructed using the 5-digit Barker code. This bandpassed matched filter has the desirable feature that it does not employ modulation or demodulation equipment, the modulation being inherent in the system. The basic construction uses the link structure, with the modification of separable links which permit easy alinement and the changing or enlarging of the code as desired. The need for negative digits in the Barker code is filled by the design and construction of special passive, inverter networks that simply invert the signals appearing at the input. The performance of networks with from one to six links and of the inverter network is shown. The operation of the bandpassed matched filter is given by the impulse responses of the coded-pulse generator and the matched receiver, and by the overall system response. The measured ratio of central peak to side lobes was 3.6:1, which is close to 70% of the theoretically predicted value. Author

N65-21537# Los Alamos Scientific Lab., N. Mex.
RADAR ATTENUATION DUE TO DELAYED γ RAYS FROM HIGH ALTITUDE NUCLEAR EXPLOSIONS
R. C. Mjolsness and A. G. Petschek 30 Mar. 1965 57 p refs
(Contract W-7405-ENG-36)
(LA-3129)

The theory of enhanced radar attenuation due to nuclear explosions is developed for radar paths outside the fireball region, and for ionization produced by delayed gamma rays. The basic equations are discussed, and a number of neglected effects are shown to be small in most cases. Values of parameters entering the equations are given and their justification is discussed in detail. It is shown that the radar attenuation may be expressed as a single integral over the radar path. An extensive asymptotic evaluation of the integral is given and applied to a rough parametric study of the attenuation phenomena. Author

N65-21552# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
A SHOCK TUBE STUDY OF THE BLUNT BODY SHOCK LAYER AND PLASMA SHEATH THERMAL NOISE EMISSION
James E. Hartsel (M.S. Thesis) 15 Mar. 1965 72 p refs
(Contract AF 33(657)-10523)
(Rept.-1573-9; AD-460385)

The shock layer of a blunt two-dimensional body in a hypervelocity shock tube flow is investigated by schlieren photography and microwave measurements of the hot gas thermal noise emission. The similarity to hypersonic flight of a like body is compared in terms of the inviscid flow parameters of shock detachment, shock shape, and body pressure distribution. A calculated numerical comparison of the flow fields of blunt flat plates in a shock tube and in a typical reentry flight condition is presented, and the use of the shock tube for measuring thermal noise is discussed. Thermal noise measurements at X-band (10 Gc) on the blunt plate afterbody have been made in the shock tube using both simple and choked antennas to investigate the reduction of the thermal noise level due to the thermal boundary layer over the body. Author

N65-21564# Battelle Inst., Frankfurt am Main (West Germany).
RESEARCH IN CONNECTION WITH PROPAGATION OF HIGH FREQUENCY (HF) WAVES Final Technical Report, Jul. 1, 1963–Dec. 31, 1964
Joseph Eitzenberger, K. Kammerlander, A. Lasar, K. Vetter, and W. Wessendorf 28 Feb. 1965 77 p
(Contract DA-91-591-EUC-1873)
(AD-460779)

During August 1963 a short-wave Minispot receiving station was put into operation at Eschborn near Frankfurt. The station was established to measure the influence of the aurora zone on signals of the Minispot transmitter built in Okinawa. These measurements were part of the Minispot program and were performed simultaneously with the measurements at Okinawa, Salonika, and Malta. Apart from measuring the influence of the aurora zone (direction effect), these measurements also included the determination of the Doppler effect caused by fluctuations of the ionosphere layers and the recording of the field strength of the signals. In addition, the sidebands of the signals, which are formed by way of propagation owing to extremely rapid fluctuations of these layers, were recorded on tape. Author

N65-21565# Battelle Inst., Frankfurt am Main (West Germany).
RESEARCH IN CONNECTION WITH PROPAGATION OF VERY LOW FREQUENCIES (VLF) Final Technical Report, Jul. 1, 1964–Dec. 31, 1964
Joseph Eitzenberger, W. Fischer, J. K. Harbauer, J. Hillmann, and G. Ries 31 Jan. 1965 103 p refs
(Contract DA-91-591-EUC-1873)
(AD-460780)

The present report summarizes the results of the work conducted during the past 3 1/2 years at Battelle Institute, in the field of vlf reception and propagation. The receiving equipment used in the initial stage of research had a partly mechanically operated servo loop. A receiving device with an electronic filter of extremely small bandwidth was developed. The bandwidth and the response time of recording can be easily accommodated to the signal-to-noise ratio. An extensive noise suppression is reached by various circuit arrangements. The results furnished by the analysis of the phase and amplitude recordings for large distances ($d > 5000$ km) between transmitter and receiver confirmed the model of one-mode propagation. For explaining details, especially during sunrise and sunset, the higher-order modes have to be taken into consideration. At smaller distances (720 km) between transmitter and receiver the interference between the ground wave and the different sky waves leads to irregular phase and amplitude variations for the resultant field strength. Author

N65-21610# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF WAVE DIFFRACTION AND PROPAGATION. I: PROPAGATION OF RADIO WAVES
E. M. Gyunninen, ed. 2 Apr. 1965 192 p refs Transl. into ENGLISH of the book "Problemy Difraktsii i Rasprostraneniya Volн. 1. Rasprostraneniye Radiovoln" Leningrad, Publishing House of Leningrad Univ., 1962 p 1–164
(JPRS-29418; TT-65-30647) CFSTI: $5.00

CONTENTS:

1. SOLUTION OF STANDARD EQUATIONS FOR IONOSPHERIC LAYERS G. I. Makarov p 3–26 refs (See N65-21611 11-13)

2. ASYMPTOTIC REPRESENTATIONS OF WHITTAKER FUNCTIONS E. M. Gyunninen and G. I. Makarov p 27–71

refs (See N65-21612 11-13)

3. ASYMPTOTIC REPRESENTATIONS OF SOLUTIONS OF MAXWELL EQUATIONS IN SMOOTH IONOSPHERIC LAYERS G. I. Makarov p 72–110 refs (See N65-21613 11-07)

4. PROPAGATION OF ELECTROMAGNETIC WAVES OVER A SURFACE WITH ARBITRARY SURFACE IMPEDANCE G. I. Makarov and V. V. Novikov p 111–132 refs (See N65-21614 11-07)

5. RADIO WAVE PROPAGATION OVER A LAYERED PATH V. V. Novikov p 133–151 refs (See N65-21615 11-07)

6. PROPAGATION OF AN ELECTROMAGNETIC PULSE OVER A SPHERICAL EARTH E. M. Gyunninen and G. I. Makarov p 152–163 refs (See N65-21616 11-07)

7. POSSIBILITIES OF THE USE OF HIGH-FREQUENCY ELECTROMAGNETIC OSCILLATIONS IN EXPLORATION GEOPHYSICS A. K. Bulgakov and V. M. Rysakov p 164–172 refs (See N65-21617 11-13)

8. EXPERIMENTAL INVESTIGATION OF TRANSIENT PROCESSES IN RADIO WAVE PROPAGATION A. K. Bulgakov and V. M. Rysakov p 173–178 refs (See N65-21618 11-07)

9. THE ACCURACY OF APPROXIMATE FORMULAS OF PROPAGATION OF PULSE SIGNALS OVER A PLANE HOMOGENEOUS SURFACE V. V. Novikov p 179–188 refs (See N65-21619 11-07)

N65-21613 Joint Publications Research Service, Washington, D. C.

ASYMPTOTIC REPRESENTATIONS OF SOLUTIONS OF MAXWELL EQUATIONS IN SMOOTH IONOSPHERIC LAYERS

G. I. Makarov *In its* Probl. of Wave Diffraction and Propagation 1965 p 72–110 refs (See N65-21610 11-07) CFSTI: $5.00

Equations for propagation of plane electromagnetic waves in bounded and smooth unbounded layers are derived. The standard-equation method is used in obtaining asymptotic representations of the Maxwell equations. Losses in the medium are initially neglected and then the results are generalized for the case of an absorbing medium; formulas are developed which make it possible to take into account the losses in collision. An appendix is included on the accuracy of the asymptotic representations. J.M.D.

N65-21614 Joint Publications Research Service, Washington, D. C.

PROPAGATION OF ELECTROMAGNETIC WAVES OVER A SURFACE WITH ARBITRARY SURFACE IMPEDANCE

G. I. Makarov and V. V. Novikov *In its* Probl. of Wave Diffraction and Propagation 1965 p 111–132 refs (See N65-21610 11-07) CFSTI: $5.00

Radio wave propagation over layered paths above the earth, with a field at a distance from the radiator not exceeding 150 km, is studied. The surface impedance method is used to obtain power-law and asymptotic expansions, and to derive an approximate formula for solution of the problem. The concept of surface impedance, and its relationship to approximate boundary conditions, are discussed. Errors are evaluated which arise in use of the surface impedance method for the classical Sommerfield problem of radio wave propagation over a plane discontinuity between two homogeneous isotropic media. Data are presented on the structure of the electromagnetic field over a plane surface having a specified surface impedance. It is stated that the results of this study can be used in solving similar propagation problems in the theory of channeling energy of superhigh frequencies and in the theory of surface waves and of delay systems. J.M.D.

N65-21615 Joint Publications Research Service, Washington, D. C.

RADIO WAVE PROPAGATION OVER A LAYERED PATH

V. V. Novikov *In its* Probl. of Wave Diffraction and Propagation 1965 p 133–151 refs (See N65-21610 11-07) CFSTI: $5.00

In the problem of radio wave propagation over a layered path, rigorous and approximate methods of solution are presented for comparison. A precise expression is formulated for the components of the electromagnetic field of a vertical antenna situated at a specified height over a path that consists of two layers; the conductance values and dielectric constants are also specified for the layers, and one layer is finite while the other is infinite in thickness. One approximation method involves use of the stationary phase method to obtain an approximate integration of the expression for field potential in the upper medium. The surface impedance method is presented as another means of approximation. A numerical approximation (which coincides with the surface impedance expression) for field potential is derived, and computations of the structure of the electromagnetic field over a layered path are presented. J.M.D.

N65-21616 Joint Publications Research Service, Washington, D. C.

PROPAGATION OF AN ELECTROMAGNETIC PULSE OVER A SPHERICAL EARTH

E. M. Gyunninen and G. I. Makarov *In its* Probl. of Wave Diffraction and Propagation 1965 p 152–163 refs (See N65-21610 11-07) CFSTI: $5.00

Propagation of an electromagnetic pulse over a spherical earth is studied, where the antenna current has the form of an included sine or cosine curve called a pulse with a duty cycle. This study of wave propagation differs from many others in not requiring the simplifying assumption that the earth has a flat surface, and in assuming that the earth's surface has an electric dipole field with current in the form of a pulse with a duty cycle. In deriving values for the parameters of the dipole field, a numerical method was used based on available numerical data on the theory of the diffraction of stationary radio waves around the earth. Change in the shape of a duty-cycle pulse during propagation over the surface of the earth was calculated. A study was made of the change of the field in time for different soils, distances to the source, and frequencies of the pulse. Together with real soils, the case of an ideally conducting ground was considered which made it possible to take into account the curvature of the earth's surface. J.M.D.

N65-21618 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL INVESTIGATION OF TRANSIENT PROCESSES IN RADIO WAVE PROPAGATION

A. K. Bulgakov and V. M. Rysakov *In its* Probl. of Wave Diffraction and Propagation 1965 p 173–178 refs (See N65-21610 11-07) CFSTI: $5.00

In studying propagation of pulse radio signals over paths with allowance for transient processes in an antenna of finite length, an experimental investigation was made of the shape of the radiated pulse during its propagation over different paths. A vertical-spire transmitter 18 meters tall was fed a current of the type $i = 1(t) \cos \omega_0 t$ with a duty frequency

of 550 kc/s. The radiated signal was received by a vertical antenna 0.5 m tall, amplified by a band-pass amplifier, and fed to the input of a double-trace oscillograph with driven sweep, and the screen was photographed. Time marks were fed to the second trace of the oscillograph. In part of the experiment the pulse was propagated over two-layer structures. Distortions of pulse shape are discussed with respect to attenuation factor, displacement current, dielectric constant, magnetic permeability, and conductance. J.M.D.

N65-21619 Joint Publications Research Service, Washington, D. C.

THE ACCURACY OF APPROXIMATE FORMULAS OF PROPAGATION OF PULSE SIGNALS OVER A PLANE HOMOGENEOUS SURFACE

V. V. Novikov *In its* Probl. of Wave Diffraction and Propagation 1965 p 179–188 refs (See N65-21610 11-07) CFSTI: $5.00

Accuracy of an approximate formula for field potential spectrum is evaluated in the problem of propagation of electromagnetic waves. The radiator specified in this theoretical analysis is a vertical electrical dipole situated on a plane discontinuity between two homogeneous isotropic media. Both stationary regime condition of harmonic dependence of the field on time, and propagation of pulse signals, are considered. It was concluded that the presence of conductance should lead to a considerable decrease in the error of the approximate field formula, since in this case there is an increase in accuracy for the spectrum at low frequencies. In the case of conducting paths, the approximate formulas correctly describe the nonstationary part of the field (with accuracy to several percent) to values of the order of 10^{-4} of the maximum, beginning at distances from the dipole greater than 10 km. J.M.D.

N65-21652*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONSIDERATIONS FOR OPTIMIZATION OF GROUND SYSTEM FOR RECEPTION OF TELEVISION FROM THE APOLLO SPACECRAFT AT LUNAR DISTANCE

George Hondros 1 Mar. 1965 45 p

(NASA-TM-X-55181; X-512-65-135) CFSTI: HC $2.00/MF $0.50

The results of a theoretical as well as an experimental investigation pertaining to the Apollo television link are presented. Emphasis is placed on improving the link by changing certain parameters in the present design of the ground system. Results also indicate that certain considerations in the design of the spacecraft equipment can contribute in obtaining good quality of video signals from the Apollo spacecraft at lunar distance. Author

N65-21660*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NOISE TEMPERATURE MEASUREMENT OF 40-FOOT AND 85-FOOT STADAN REFLECTOR ANTENNAS

Charles E. H. Edward and Paul A. Lantz Feb. 1965 19 p ref

(NASA-TM-X-55190; X-525-65-31) CFSTI: HC $1.00/MF $0.50

A portable solid-state Dicke radiometer for use at 1.7 and 4.0 Gc is described. One application of this device to the measurement of the noise temperature of 40- and 85-foot reflector antennas is discussed. It is shown that measured values of temperatures fall within theoretical bounds. Author

N65-21661*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STUDY OF AN R. F. TO R. F. SATELLITE TRANSPONDER

Walter K. Allen, Louis J. Ipolito, and Clay Prillaman Feb. 1965 132 p refs

(NASA-TM-X-55193; X-625-65-41) CFSTI: HC $4.00/MF $1.00

A program was conducted to investigate the feasibility of a wideband, direct rf to rf conversion communication satellite transponder, utilizing a TWT in a reentrant mode. After amplification by the TWT, the signal(s) are frequency translated and reamplified by the same TWT. Pre- and post-amplification is provided to establish system sensitivity and dc to rf conversion efficiency. The optimum transponder type and configuration were determined, fabricated, and evaluated. Analysis of the measured performance is presented with emphasis on the baseband distortion characteristics for both single and multiple signals. Unusual characteristics of the TWT as operated in the reentrant mode are also analyzed and presented. The gain, output power, and noise figure obtained with the reentrant transponder were established to be consistent with the basic requirements of a communication satellite. The major advantages offered are reduced transponder complexity and the extremely wide bandwidths which can be realized. Author

N65-21666*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LOW NOISE TUNNEL DIODE RECEIVERS FOR SATELLITE APPLICATION

John B. Williams, Joseph Deskevich, and Michael A. Galli 17 Feb. 1965 54 p

(NASA-TM-X-55203; X-625-65-82) CFSTI: HC $3.00/MF $0.50

The feasibility of using a tunnel diode receiver to provide improved characteristics for the front end of a communication satellite transponder is studied. Preamplification at a lower noise figure can be provided to establish optimum sensitivity and efficiency for the receiving section of the transponder; this in turn can allow a reduction in ground-transmitted power. Analysis and measured performance are presented with emphasis on saturation, noise, and small signal gain vs frequency. A comparison of the tunnel diode receiver to other low-noise amplification devices for satellite application is also included as is an analysis of its possible use with the Applications Technology Satellite. Author

N65-21668*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE RANGE RATE ERROR DUE TO THE AVERAGING TECHNIQUES OF DOPPLER MEASUREMENTS

B. Kruger 5 Mar. 1965 28 p refs

(NASA-TM-X-55205; X-513-65-100) CFSTI: HC $2.00/MF $0.50

The averaging error in slant range-rate measurements, based on Doppler frequency integration over a finite time, was analyzed. This error is of such a magnitude that a correction is required. For example, in a near-circular earth orbit the error is 0.12 m/s for 370 km (200 nm) orbit altitude and 0.5 m/s for 185 km (100 nm) orbit altitude if an integration time of 1 sec is used. Means of correction, added noise due to correction, and the residual error after correction are discussed. Special emphasis is given to the three-point correction, which is shown to be adequate in most applications. In the above case, the errors are reduced to 0.0001 m/s and 0.0024 m/s, respectively. Author

N65-21753# Illinois Univ., Urbana. Antenna Lab.
BALANCED BACKFIRE ZIGZAG ANTENNAS
Paul E. Mayes Oct. 1964 14 p refs
(Contract AF 33(657)-10474)
(TR-82; AD-607423)

Linearly polarized backfire antennas described have high front-to-back ratio and very low sidelobes. The backfire radiation is produced from a meandering conductor. The principal directional characteristics can be determined by using linear array theory. When the conductor is periodic this can be related to a series expansion of the fields in space harmonics. A simple first-order theory for the periodic zigzag is based upon known properties of waves on linear conductors. The perturbations from this theory are then related to the introduction of space harmonics in the periodic case. Measured frequency versus phase constant (k-β) diagrams are presented to illustrate the correspondence to the first-order theory and to accurate theoretical solutions for propagation on helical conductors. The radiation properties of periodic backfire zigzags are compared to the end-fire type previously reported. Author

N65-21806# California Univ., Berkeley. Electronics Research Lab.
SOLUTION OF CIRCULAR LOOP ANTENNAS AND SCATTERING FROM CONDUCTING LOOPS BY NUMERICAL METHODS
A. Baghdasarian and D. J. Angelakos 8 Jan. 1965 31 p refs
(Grant AF-AFOSR-139-64)
(Rept.-65-1; AD-457192)

The integral equation of the current distribution along a circular loop antenna is solved by numerical methods. It is shown that the integral equation can be converted into a set of linear simultaneous equations, solutions of which give the current distribution. First, the loop antenna driven by a voltage source is considered and solutions to loops of various sizes are obtained. Secondly, current distributions are obtained for the loop as a scatterer illuminated by a plane wave. Finally, from the knowledge of the current on the illuminated loops, backscattering patterns are obtained for rotating loops. Measurements are performed for the latter case, and the results compared with calculations. Author

N65-21819# Institute for Defense Analyses, Washington, D. C. Research and Engineering Support Div.
MULTIPLE ACCESS TO A COMMUNICATION SATELLITE WITH A HARD-LIMITING REPEATER. VOLUME I: MODULATION TECHNIQUES AND THEIR APPLICATIONS
J. Kaiser, J. W. Schwartz, and J. M. Aein Jan. 1965 86 p refs
(Contract ARPA SD-50)
(IDA-R-108, Vol. I; AD-457945)

Four modulation techniques applicable to a wideband nonlinear repeater and their characteristics are described. The first is the frequency-division multiple access (FDMA), in which the number of access channels obtainable is a function of the type of message modulation in each access channel, up-link power control, and the sensitivity of each of the receiver stations. The second is the spread-spectrum multiple access (SSMA). In constant-envelope SSMA each carrier signal usually occupies the entire repeater bandwidth. An access channel consists of a carrier waveform characterized by a distinct wideband angle modulation. The third technique is the time-division multiple access (TDMA) in which the transmissions in different links do not overlap in the repeater, and each link is assigned exclusive use of the repeater during specified time slots; in this manner, the signals pass through the repeater with no interaction. The fourth and last technique is the pulse-address multiple access (PAMA) in which the pulses within specific frequency bands and the intervals between the pulses in a given carrier waveform constitute a distinct pattern. The amount of time that pulse is present is much less than the amount of time no pulse is present. The same patterns are used to carry each message sample.
R.W.H.

N65-21828 Radio Corp. of America, Camden, N. J. Communications Systems Div.
MICROWAVE SYSTEMS AND DEVICES
[1964] 59 p refs

CONTENTS:

1. AN/TRC-97—NEW MICROWAVE MULTICHANNEL EQUIPMENT FOR TROPOSCATTER, DIFFRACTION, OR LINE-OF-SIGHT TACTICAL COMMUNICATIONS W. J. Connor and E. J. Sass p 2–6 (See N65-21829 11-07)
2. RELAY SATELLITE COMMUNICATIONS SYSTEM J. Kiesling, W. Maco, and S. Goldman p 7–13 (See N65-21830 11-07)
3. FUTURE MICROWAVE COMMUNICATIONS REPEATERS FOR SPACE A. L. Berman and J. Kiesling p 14–16 refs (See N65-21831 11-07)
4. DESIGN OF CW-60 SOLID-STATE MICROWAVE RELAY EQUIPMENT E. J. Forbes p 17–20 refs (See N65-21832 11-07)
5. MICROWAVE RESEARCH, DEVICES FOR THE FUTURE L. S. Nergaard p 21–23 refs (See N65-21833 11-09)
6. RECENT RESEARCH ON LOW-NOISE TRAVELING-WAVE TUBES S. Bloom p 24–25 refs (See N65-21834 11-09)
7. LOW- AND MEDIUM-POWER TRAVELING-WAVE TUBES AS VERSATILE BROADBAND MICROWAVE AMPLIFIERS, A REVIEW H. J. Wolkstein, R. W. Mc Murrough, and G. Novak p 26–31 refs (See N65-21835 11-09)
8. MINIATURE C-BAND SOLID-STATE FREQUENCY MULTIPLIER FOR MISSILES J. J. Napoleon, D. E. Nelson, and C. L. Cuccia p 32–37 refs (See N65-21836 11-09)
9. MICROWAVE TUNNEL-DIODE AMPLIFIERS AND OSCILLATORS D. E. Nelson, A. Presser, E. Casterline, and R. M. Minton p 38–41 refs (See N65-21837 11-09)
10. MIPIR RADAR RECEIVER—A THREE-CHANNEL REMOTE-TUNED PARAMETRIC AMPLIFIER H. B. Yin p 42–45 refs (See N65-21838 11-07)
11. ELECTRON-BEAM-PLASMA AMPLIFIERS: A FUTURE IN MILLIMETER-WAVE AMPLIFICATION G. A. Swartz p 46–48 refs (See N65-21839 11-09)
12. MICROWAVE BREAKDOWN IN SPACE COMMUNICATIONS: A CASE STUDY OF RANGER VI AND VII T. D. Breeden p 49–53 refs (See N65-21840 11-07)
13. ENGINEERING AND RESEARCH NOTES. BRIEF TECHNICAL PAPERS OF CURRENT INTEREST A. S. Clorfeine et al p 54–55 refs

N65-21829 Radio Corp. of America, Camden, N. J. Communications Systems Div.
AN/TRC-97—NEW MICROWAVE MULTICHANNEL EQUIPMENT FOR TROPOSCATTER, DIFFRACTION, OR LINE-OF-SIGHT TACTICAL COMMUNICATIONS
W. J. Connor and E. J. Sass *In its* Microwave Systems and Devices [1964] p 2–6 (See N65-21828 11-07)

The AN/TRC-97 wideband microwave military tactical communications equipment is described. The equipment provides full duplex multichannel voice, data, and teletype communications in the 4400- to 5000-Mc band using line of sight, diffraction, or tropospheric scatter media. The receiver

and transmitter are all solid state, except for the exciter traveling wave tube and the 1-kW klystron. Pertinent statistical data on system performance, and multiplex transmission parameters are given. The equipment, which is transportable by truck or helicopter is especially designed for quick reaction tactical use, in which tropospheric scatter communications can be established in less than 1 hour after arriving at the sites. L.S.

N65-21830 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

RELAY SATELLITE COMMUNICATIONS SYSTEM

J. Kiesling, W. Maco, and S. Goldman *In* RCA, Camden Microwave Systems and Devices [1964] p 7–13 (See N65-21828 11-07)

Long-distance, high-capacity communications systems may be established using microwave repeaters in earth-orbiting satellites. The problems associated with the operation of these repeaters in the environment of outer space were explored using the Relay satellites. The performance objectives and design criteria for the repeaters in the Relay satellite are given, and the ground-station network is described. It is shown that the ground station network, the launch and orbiting constraints, and the outer space environment impose severe restrictions upon the design of this satellite system. The experience with the Relay satellites has shown, however, that a proper consideration of these restrictions, in addition to careful processing and testing, can result in long-lived performance in the space environment. Author

N65-21831 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

FUTURE MICROWAVE COMMUNICATIONS REPEATERS FOR SPACE

A. L. Berman and J. Kiesling *In* RCA, Camden Microwave Systems and Devices [1964] p 14–16 refs (See N65-21828 11-07)

Improved booster performance coupled with an ever advancing technology has created a need for improved performance in space communications equipment. Several microwave communications repeaters are described which use various configurations of solid-state devices, conventional heterodyning, and traveling wave tubes. Limitations in power and bandwidth are discussed. It is shown that peripheral problems relating to modulation techniques, spacecraft stabilization, spacecraft power, and user access have a critical bearing on the design, performance, and reliability of the equipment. Author

N65-21832 Radio Corp. of America, Camden, N. J. Broadcast and Communications Products Div.

DESIGN OF CW-60 SOLID-STATE MICROWAVE RELAY EQUIPMENT

E. J. Forbes *In its* Microwave Systems and Devices [1964] p 17–20 refs (See N65-21828 11-07)

The design of the CW-60 solid-state microwave relay system is given. The 240-voice channel, 6000-Mc unit meets the required standards for medium capacity and long haul service. An additional feature is a 120-voice channel insert capability at through repeaters. Reliability, maintainability, and longevity characterize this equipment. L.S.

N65-21838 Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.

MIPIR RADAR RECEIVER—A THREE-CHANNEL REMOTE-TUNED PARAMETRIC AMPLIFIER

H. B. Yin *In* RCA, Camden Microwave Systems and Devices [1964] p 42–45 refs (See N65-21828 11-07)

The parametric amplifiers described have improved radar tracking sensitivity. Single-knob remote tuning allows changes of tracking assignments between beacon and skin and provides fine tuning to compensate for transmitter or beacon drift. The amplifier was installed in several operational radars, and its performance is being evaluated. Author

N65-21840 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

MICROWAVE BREAKDOWN IN SPACE COMMUNICATIONS: A CASE STUDY OF RANGER VI AND VII

T. D. Breeden *In* RCA, Camden Microwave Systems and Devices [1964] p 49–53 refs (See N65-21828 11-07)

This paper describes the successful effort that eliminated the voltage breakdowns from the passive components of the rf coaxial lines of the Ranger TV subsystem, and includes a consideration of the general rf voltage breakdown problem. Initial tests of the TV and communications subsystem of the Ranger VI spacecraft revealed the presence of rf output power dropouts. The random dropouts occurred in simulated space environments consisting primarily of test vacuum levels of 10^{-4} torr or less. Visual examination of suspected components revealed that rf voltage breakdowns were the cause of the power dropouts. Voltage breakdowns were eliminated from the cavity-tube power amplifiers by pressurizing. The same technique was successfully used on the 50-ohm dummy load component. However, pressurizing did not provide a desirable solution of the elimination of breakdowns from microwave coaxial components, such as the radio-frequency connectors or the four-port hybrid. Voltage breakdowns were eliminated from the microwave coaxial components by careful incorporation of special designs which are detailed. Author

N65-21843# Navy Electronics Lab., San Diego, Calif.

AUTOMATIC DISTRIBUTION-FREE STATISTICAL SIGNAL DETECTION Research Report, Aug. 1961–Jun. 1964

C. B. Bell 16 Oct. 1964 148 p refs

(NEL-1245; AD-456962)

Distribution-free statistical techniques are reviewed and evaluated for possible application to the signal detection problem. These techniques are classified into three types: (1) the noise distribution is known but the signal-plus-noise is not; (2) neither distribution is known but a pure-noise sample is available; and (3) the distributions and a pure-noise sample are all unavailable. Several of the distribution-free detectors are almost as efficient as their parametric counterparts, and several are uniformly better than the parametric detectors for certain classes of Gaussian noise. Author

N65-21881# Bell Telephone Labs., Inc., Whippany, N. J.

TEST PROGRAM FOR TROPOSCATTER COMMUNICATIONS LINKS, PHASE I OF DCA-12 STUDY Final Report

4 Dec. 1964 53 p Prepared for Defense Commun. Agency

(AD-609925)

Recommendations for tests of 2.4- and 38.4-kbs data transmission on troposcatter radio relay sections are given. It is recommended that the tests be designed around an error recording facility which records error, synchronizing, and radio

signal information in IBM format to allow automatic computer analysis. The recommended data sets are four-phase data models. It is suggested that the tests be conducted on the RADC Model City to Verona section or on an AT&T tropo system. Laboratory simulation of field measurements is also suggested. The emphasis throughout is on practical data tests with measurements of the medium relegated to an auxiliary role. A brief review of the recently published studies by Sunde and by Bello and Nelin is included. Author

N65-21915# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A COMPLETE MODE SUM FOR LF, VLF, ELF TERRESTRIAL RADIO WAVE FIELDS

J. Ralph Johler and Leslie A. Berry 1 Oct. 1964 26 p refs
(NBS-Monograph-78)

Previous papers about vlf, elf propagation in the earth-ionosphere waveguide emphasized characteristics of the individual modes. In this paper, emphasis is on the total field found by summing all modes which contribute appreciably. Solutions are given and calculations made for a homogeneous isotropic ionosphere, a homogeneous ionosphere with a constant radial magnetic field imposed, and an ionosphere with a magnetic field of arbitrary dip angle. In the isotropic case, one mode is sufficient to describe the field at elf, but at the upper end of the vlf band, two or more modes may propagate 7500 km. When a magnetic field is imposed on the ionosphere, three abnormal modes or fields are generated at the anisotropic boundary. These abnormal modes have little effect on the total field in the vlf band, but they change the elf field appreciably. Indeed, in the absorption region between vlf and elf, the abnormal modes may become dominant beyond 1000 km. Author

N65-22012# Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.

FREQUENCY RESPONSE, NOISE, AND PULSE TRANSMISSION IN AN FM/FM TELEMETRY SYSTEM

C. F. Asquith 1 Feb. 1965 25 p ref
(RG-TR-65-3; AD-460324)

This report presents experimental data taken in a study of a standard FM–FM telemetry system. The objective of the program is to assign each onboard missile measurement to an optimum telemetry channel. Taken into account are noise to be tolerated and frequency response characteristics, assuming a reasonable estimate of signal behavior. Pulses and repetitive waveforms are used to determine transmission capability. Author

N65-22017# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

INHERENT ERRORS IN A DIRECTION FINDING SYSTEM USING LOG PERIODIC ANTENNAS

Claes T. Elfving 31 Aug. 1964 50 p
(Contract FA-36-039-AMC-03404(E))
(EDL-M738; AD-460609)

A study to determine the direction-finding errors inherent in an amplitude-comparison direction-finding (DF) system using log periodic antennas has been conducted. Two factors were found to contribute to the errors of the system. One is a small polarization variation with frequency inherent in the folded log periodic antennas; the other is the geometry of the DF antenna system. This report describes the experimental investigation conducted to determine the magnitudes of these effects and shows some of the measured data. Author

N65-22040# Naval Civil Engineering Lab., Port Hueneme, Calif.

STATE OF THE ART—UNINTERRUPTIBLE POWER SYSTEMS

Evo Giorgi 28 Jan. 1965 29 p refs
(TN-N-686; AD-457831)

A state-of-the-art study was initiated concurrently with the investigation of operational requirements to establish a basis from which development work could proceed. This note reviews the state of technology achieved in the development of uninterruptible power supply systems and discusses in some detail developmental and operational problems to be resolved in the application of these systems at naval shore facilities. Author

N65-22053# Gt. Brit. Dept. of Scientific and Industrial Research.

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: SEPTEMBER 1964 (PART A)

1965 55 p *Its* Issue 4

The satellite observations of 1960 Eta 3 (Transit 2A Rocket), 1961 Omicron 1 (Transit 4A), 1961 Sigma 1 (Midas 3), 1961 Alpha-Delta 1 (Midas 4), 1962 Kappa 1 (Midas 5), and 1962 Beta-Alpha 2 (Alouette Rocket) are presented. E.E.B.

N65-22055# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: SEPTEMBER 1964 (PART B)

1965 47 p *Its* Issue No. 5

N65-22077# White Sands Missile Range, N. Mex. Instrumentation Development Directorate

ELECTROMAGNETIC WAVE PROPAGATION IN MEDIA OF PERIODICALLY TIME-VARYING PERMITTIVITY

Dieter E. Holberg (Ph.D. Thesis—N. Mex. Univ.) Jan. 1965 153 p refs
(STEWS-ID-65-4; AD-457086)

The propagation of electromagnetic plane waves in a nonconducting, charge-free medium with a periodically time-varying permittivity given by $\epsilon(t) = \epsilon/(1 - 2p\cos 2\Omega t)$, was studied theoretically. Under this assumed form for permittivity, the wave equation for electric displacement is separated into Mathieu's equation for the time dependence and Helmholtz' equation for the space dependence of the field. It is shown that in an infinite space of periodically time-varying permittivity waves with amplitudes increasing exponentially in time can be maintained; conditions under which such waves may also occur in a permittivity-modulated slab oriented normal to the propagation vector are investigated. Closed and iterative forms are given for $2p_0$, the critical modulation index. A method employing partial difference equations is presented and applied to exponentially increasing waves in a dielectric slab, and results are in good agreement with those obtained by using Mathieu functions. J.M.D.

N65-22111# Michigan Univ., Ann Arbor. Radio Science Lab.

A POLARIZING SCREEN FOR BEYOND-LINE-OF-SIGHT DATA TRANSMISSION

James A. Rupke Nov. 1964 40 p refs
(Contract DA-36-039-SC-78801)
(Rept.-2900-493-T; AD-451974)

Data transmission at radio frequencies at distances greater than the line of sight requires a relay (active or passive) visible to both transmitter and receiver. This report contains experimental and theoretical work on a polarizing screen to be used as a passive relay in the data-transmission system. Design criteria for the construction of the polarizing screen are derived and applied in the construction of a small experimental screen. The results are also presented in the form of three families of curves applicable to a wide range of systems. Author

N65-22140# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory
ON THE CONNECTION BETWEEN LINEAR POLARIZATION AND GALACTIC LATITUDE OF DISCRETE RADIO SOURCES
P. Maltby 1965 9 p refs *Its* Observations No. 3
(Contract Nonr-220(19))
(AD-457725)

The degree of linear polarization at a wavelength of about 21 cm is considered for 166 presumably extragalactic radio sources. A connection between degree of linear polarization and galactic latitude is found; low-latitude sources tend to show a lower degree of polarization than high-latitude sources. It is found that that the correlation between degree of polarization and galactic latitude is weaker at a wavelength equal to 10 cm than at 21 cm. This result is derived from a sample of 46 sources observed at both wavelengths. Possible interpretations of the correlation found at 21 cm are discussed. Author

N65-22181# National Bureau of Standards, Boulder, Colo. Boulder Labs.
ON THE CLIMATOLOGY OF GROUND-BASED RADIO DUCTS AND ASSOCIATED FADING REGIONS
E. J. Dutton 16 Jun. 1961 95 p refs
(NBS-TN-96) CFSTI: $1.75

An atmospheric duct occurs when a radio ray passing upward through the atmosphere is sufficiently refracted to travel parallel to the earth's surface. Maximum observed incidence of ducts was determined to be 13%, 10%, and 5% by analysis of 3 to 5 years of radiosonde data for a tropical, temperate, and arctic location, respectively. Annual maxima are observed in the winter for the arctic and summer for the tropics. Arctic ducts arise from ground-based temperature inversions with ground temperature less than −25° C, temperate ducts, from radiation inversions and accompanying humidity lapse; tropical ducts occur with slight temperature and humidity lapses when the surface temperature is 30° C and greater. The mean initial elevation angle of a radio ray trapped by these ducts is about 3 mr, with the maximum value about 5.8 mr. The steepest gradient of N observed is −420 N units/km. Observed ducts trap radiowaves of frequency $\geq$ 1 kMc at all locations for at least 50% of the time. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-21171# Parke Mathematical Labs., Inc., Carlisle, Mass.
COMBINATORIAL PROPERTIES OF VARIABLE-LENGTH, ERROR-CORRECTING CODES Scientific Report No. 2
Lorenzo Calabi and John A. Riley Dec. 1964 48 p refs *Its* Rept.-3826-SR-2
(Contract AF 19(628)-3826)
(AFCRL-65-28; AD-612633)

The two theories of variable length codes and of error-correcting block codes are unified by extending many of their notions and results to suitably defined variable-length, error-correcting codes. The three principal notions studied are these: (1) e-correcting codes, their relation with distance and McMillan inequality, (e-correcting = uniquely decipherable); (2) e-dense codes and their relations to various maximality properties studied in the literature; (3) e-exhaustive codes as the extension of Huffman's codes (e=o) and of closed-packed (block) codes. Various constructions and a test for error-correcting codes are given. Author

N65-21183# European Atomic Energy Community, Brussels (Belgium).
CONTOUR MAP SUBROUTINES
P. Moinil and J. Pire Jan. 1965 24 p refs In FRENCH; ENGLISH summary
(EUR-2241.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The subroutine COMAP satisfies the necessity of representing a function of two variables by contour levels, and runs with a set of subroutines already written for the use of Data Plotter CALCOMP 506 connected to an IBM 1401. Author

N65-21272# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DATA SYSTEMS Quarterly Progress Report, Div. 2, 1 May–31 Jul. 1964
E. C. Frick and S. H. Dodd 19 Aug. 1964 20 p refs
(Contract AF 19(628)-500)
(AD-604590)

Work on *Digital Computers* included: *Computer Systems*—curve-drawing scope, new counter sequence, optical input, multiuser consoles, and symbolic page address transformation; *Circuit Development*—circuits for SPAT, UHF switching transistors, and transistor flip-flop memory; *Magnetic Film Engineering*—substrate cleaning, page address memory, and other studies; and *System Programming and Application*—CORAL system, and circuit simulator. Work on *Computer Components* centered on: *Magnetic Films; Electron Transport;* and *Film-Memory Sense Amplifier.* Studies in *Psychology* pertained to: *Automatic Procedure Executor; Human Information Processes;* and *Man–Machine Communication.* Studies in *Control Research* pertained to: *On-Line Use of Hybrid Computers;* and *Data Storage and Retrieval.* G.G.

N65-21302*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN STUDY OF ERROR-DETECTING AND ERROR-CORRECTING SHIFT REGISTER
F. Michael Horn 15 Apr. 1965 24 p
(Contract NAS7-100)
(NASA-CR-57983; JPL-TR-32-716) CFSTI: HC $1.00/MF $0.50

This report details the design study of an N-bit error-detecting and error-correcting (NEDEC) shift register, N being the number of stages in the device. Design criteria are discussed, and NEDEC philosophy, mechanization, and development are detailed. A six-stage circulating register was constructed and successfully tested over the temperature range −20° to +100° C.

Several representative peripheral circuits are included, together with proposed feedback-logic mechanization. Advantages and disadvantages are enumerated. Test data are given for reference. Author

N65-21382*# Case Inst. of Tech., Cleveland, Ohio. Digital Systems Lab.

A DIGITAL CONTROLLER EMPLOYING TRUNCATED LOGARITHMIC QUANTIZATION

John B. Peatman Aug. 1964 154 p refs
(Grant NsG-36-60)
(NASA-CR-57858; EDC-1-64-28) CFSTI: HC $5.00/MF $1.00

The logic involved in the design of a digital controller is examined. To reduce the logic requirements, a method of information quantization is utilized. This quantization scheme, called truncated logarithmic quantization, leads to reduced information storage requirements. Multiplication by a constant can be handled as a natural consequence of using this quantizing scheme, without requiring any additional logic. The adequacy of this scheme in a control application is first simulated on a general purpose digital computer and then experimentally verified on a two-capacity liquid level system. Design considerations are discussed thoroughly. A prototype was constructed in which the design is divided into eight functional blocks, each of which is implemented on a 4- by 6-in. printed circuit board. To achieve this degree of simplification, several special-purpose digital logic elements were utilized. Author

N65-21396 New York Univ., N. Y. Courant Inst. of Mathematical Sciences

ACTIVITIES OF THE ENGINEERING RESEARCH LABORATORY, JULY 1, 1963–JUNE 30, 1964

Robert T. Shevlin 1 Aug. 1964 223 p refs
(Contract AT(30-1)-1480)
(NYO-1480-2)

CONTENTS:

1. A DIODE-SELECT COMPUTER MEMORY R. Shevlin p 7–11
2. A NONDESTRUCTIVE-READ MODE FOR FERRITE TOROIDS R. Laupheimer p 12–26 refs
3. NONDESTRUCTIVE READ (NDR) MEMORY A. Yevlove p 27–29 refs
4. AUTOMATIC CORE THREADING J. F. Marine p 30–33
5. CONSTRUCTION OF 4K WORD CORE MEMORY SYSTEM FOR ARGONNE NATIONAL LABORATORY F. Ruben p 34–68 refs
6. SENSE AMPLIFIER M. Rabinowitz p 69–79
7. MECHANICAL CONSIDERATIONS FOR THE ANLA COMMERCIAL STACK J. F. Marine p 80–113
8. SUBPROJECTS OF MEMORY SYSTEM FOR ARGONNE NATIONAL LABORATORY R. A. Trondle p 114–119
9. MEMORY EXERCISER I. Steinberg p 120–135
10. ELECTRODEPOSITION OF PERMALLOY ON WIRE M. Imai p 136–143 refs
11. TEST COMPUTER R. Bianchini and W. Orvedahl p 144–153 ref
12. PATTERN RECOGNITION R. Bianchini and M. Shostak p 154–222 refs

N65-21415# Los Alamos Scientific Lab., N. Mex.

AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. IV: FOURIER SERIES ANALYSIS

R. B. Roof, Jr., Don R. Cromer, and Allen C. Larson 16 Mar. 1965 85 p
(Contract W-7405-ENG-36)
(LA-3198) CFSTI: $3.00

The procedures employed and the computer programs used for a Fourier series analysis of X-ray intensity data are described. The programs compute Patterson vector maps and electron density maps of the Fourier and difference Fourier types. The programs may also be combined with a plotting program for a high speed microfilm recorder to obtain the maps drawn on 35-mm film. Author

N65-21443# Texas A&M Univ., College Station. Activation Analysis Research Lab.

INVESTIGATIONS IN AUTOMATED ACTIVATION ANALYSIS

Richard E. Wainerdi, Manchery P. Menon, Lloyd E. Fite, Marc Y. Cuypers, Dan Drew et al 1 Jan. 1965 360 p refs
(Contract AT(40-1)-2671-1)
(TEES-2671-4)

CONTENTS:

1. MARK II AUTOMATIC COMPUTER-COUPLED ACTIVATION ANALYSIS SYSTEM L. E. Fite 81 p refs
2. COMMUNICATION THEORY IN NEUTRON ACTIVATION ANALYSIS W. W. Wilkins 39 p refs
3. DETECTOR RESEARCH C. F. Lam 14 p refs
4. THE DETERMINATION OF PHOSPHORUS BY FAST NEUTRON ACTIVATION ANALYSIS M. To-on 37 p refs
5. SODIUM SEPARATION M. P. Menon 12 p refs
6. APPLICATION OF LINEAR ESTIMATION OF A CHEMICAL MIXTURE PROBLEM L. H. Smith and H. O. Hartley 41 p refs
7. A NEW PROGRAM FOR THE DIGITAL COMPUTER ANALYSIS OF PULSE-HEIGHT SPECTRA H. R. Phillips, J. L. Alexander, and D. D. Drew 55 p refs
8. PUBLIC BENEFIT UTILIZATIONS P. Jimenez and M. Y. Cuypers 55 p refs

N65-21511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF DECODING ST-35 CODE, NO. 2 CODE OR ANOTHER FIVE-UNIT CODE

A. S. Sharayev, R. S. Brazhenas, A. A. Martines et al 17 Jun. 1963 5 p Transl. into ENGLISH from Soviet Patent No. 144522 (Appl. No. 680008/26, 23 Sep. 1960) p 1–2
(FTD-TT-63-498/1+2; AD-411209)

A method to halve the number of telephone relays required for decoding ST-35, international No. 2 code, or any other five-unit code is described. This is attained by decoding only a part of the code combination, i.e., the second, third, fourth, and fifth pulses. The first pulse is transmitted to the combinator without code transformation. The other four pulses are also fed into the combinator via the decoder. In the combinator, two identical four-element combinations of a five-unit code are transformed into four combinations of a five-unit code. The method can be used in developing code transformers in communications systems, using telegraph devices of different codes. L.S.

N65-21515# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MAGNETIC RECORDING METHOD

B. S. Broydo 18 Jun. 1963 5 p Transl. into ENGLISH from Russian Patent No. 145073 (Appl. No. 726701/26), 17 Apr. 1961 p 1–3
(FTD-TT-63-504/1+2; AD-413595)

A method of magnetic recording–reproduction of number codes is outlined. The method is distinguished by the fact, that for the purpose of reducing the number of tracks used for recording and magnetic heads, the n discharge numbers are recorded on two tracks. The number code and two marking pulses at the beginning and end of the sending with subsequent pause in n + 2 cadences are recorded on the first track, and cadence pulses synchronized with code pulses are recorded on the second track. A pause cadence counter and a push–pull shifting register is used for recording the code into the output registers. A sketch of the device is included. E.E.B.

N65-21534# Oak Ridge National Lab., Tenn. Thermonuclear Div.
AN ELLIPTIC INTEGRAL COMPUTER PACKAGE FOR MAGNETIC FIELDS, FORCES, AND MUTUAL INDUCTANCES OF AXISYMMETRIC SYSTEMS, AND A VERSATILE LINE-TRACING ROUTINE
M. W. Garrett Apr. 1965 29 p refs
(Contract W-7405-ENG-26)
(ORNL-3575) CFSTI: $2.00

This report describes a set of high-precision routines for the IBM 7090 that perform efficiently the calculations most often required on axially symmetric magnetic systems. These routines compute the vector potential, field components, and the mixed gradient $\partial B_\rho/\partial z$ for current systems and for certain idealized distributions of magnetized matter; the force and mutual inductance are computed between coaxial units of a system; and the lines of force, lines of constant total B, B_z, etc., for such systems are traced. The tracing routine with slight changes should be able to find loci of constant values for any single-valued function of two variables, when a program exists to evaluate the function. Coaxial units of any combination may be circular loops, thin solenoids, or thick cylindrical coils; also uniformly magnetized rings, cylindrical sheets, or thick-walled cylinders. The six types may be intermixed. The programs compute fields and trace lines accurately even within the windings, and calculate force and mutual inductance between coils in contact, as well as the self-inductance of ideal solenoids and of thick cylindrical coils. Thick coils are analyzed with the solenoid rather than the loop as the elementary unit. Magnetic properties are then integrated in radial depth by gaussian numerical quadrature of variable order. Author

N65-21560# New Hampshire Univ., Durham. Dept. of Physics
AUTOMATIC DATA RECORDING SYSTEM FOR A COSMIC RAY MONITOR Scientific Report No. 4
Barry A. Billings (M.S. Thesis) and John A. Lockwood Jan. 1965 58 p refs
(Contract AF 19(628)-2352)
(AFCRL-65-13; AD-612704)

The purpose of this study was to design and construct an electronic system to record automatically the pulse trains produced in a cosmic-ray neutron monitor, designated NM-64. The system supplies signals every five minutes to an IBM 526 card punch causing it to punch on IBM tabulating cards the number of pulses recorded in each of the three separate channels of the cosmic-ray monitor during the previous five-minute interval, the time of day, and date of the month. The barometric pressure reading from a digital barometer is also tabulated on the same IBM card. Pulse counting is accomplished by three groups of decade counters for each pulse train. Each decade counter has an associated storage circuit. This stored information is then converted—from binary coded decimal to decimal form by means of a diode matrix and punched. Accurate timing is accomplished by a crystal controlled oscillator feeding cascaded frequency dividers, the output of which supplies a signal every five minutes. Author

N65-21651*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE DATA HANDLING AT GODDARD SPACE FLIGHT CENTER
T. J. Lynch Feb. 1964 9 p
(NASA-TM-X-55180; X-520-65-84) CFSTI: HC $1.00/MF $0.50

The system for handling data recorded at the tracking station is described. The experimenter's role in data handling; prelaunch data operations; data acquisition and processing; and final analysis of the data are discussed. The data system has to handle, simultaneously, different bit rates ranging in order of magnitude from 10 bits/sec to 10^5 bits/sec. A flow chart showing the space data handling for the system is included. E.E.B.

N65-21653*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IBM 7094 PROGRAM FOR THE SIX-COIL PROBLEM
Henry Miller Dec. 1964 34 p ref
(NASA-TM-X-55182; X-543-64-366) CFSTI: HC $2.00/MF $0.50

One method of producing a uniform magnetic field with a very large volume of homogeneity is to use a six-circular-coil system. This system, along with an analysis of its solution on the IBM 7094 computer using Fortran IV, is described. The problem considered is for seven unknowns of five equations. So that a finite number of solutions can be obtained, values were assumed for two of the unknowns. The flow chart of the program and the Fortran listing are included. E.E.B.

N65-21688 Radio Corp. of America, Camden, N. J.
PHOTOCOMPOSITION MACHINE FOR THE CHINESE LANGUAGE
Fred E. Shashoua *In* RCA, Burlington, Mass. Electro Optics 1964 p 56–59

The Ideographic Composing Machine (ICM) provides a means of rapidly composing high-quality Chinese ideographic characters in page format to be used as printing copy. Conventional techniques for printing Chinese are presently limited to manually selecting characters from large storage bins, and assembling the selected characters in page format to produce printing plates. This technique is cumbersome and slow when considering the large selection of characters and the duplication of these characters in multiple font sizes. To circumvent this hand operation, the ICM was designed to photocompose Chinese characters directly from a keyboard input at rates comparable to those achieved from a conventional English typewriter, but without excessive operator training. Author

N65-21689# New York Univ., N. Y. Courant Inst. of Mathematical Sciences
A COLLECTION OF MATHEMATICAL COMPUTER ROUTINES
Miriam S. Shapiro and Max Goldstein 1 Feb. 1965 395 p refs
(Contract AT(30-1)-1480)
(NYO-1480-14)

The routines presented are part of the subroutines available to users of the IBM 7094 computer. They include mathematical routines for computing Bessel functions, gamma functions, solutions of systems of linear equations, eigenvalues and eigenvectors, roots of polynomials, elliptic integrals, solutions of systems of ordinary differential equations, matrix inverses, minimization routines, and several special purpose and nonnumeric routines. The codes are either in Fortran II or in FAP, and in some cases both the Fortran and the FAP versions of the same routine are included. The symbolic deck for each routine is listed, and the standard system routines (e.g. square root, absolute value) are described. G.G.

N65-21719*# Midwest Research Inst., Kanasas City, Mo.
STUDY FOR THE INDICIAL LOAD EFFECTS ON MULTI-STAGE SPACE VEHICLE SYSTEMS. VOLUME III: A DESCRIPTION OF THE COMPUTER PROGRAM EMPLOYED Annual Summary Report, 21 Jun. 1963–20 Aug. 1964
Duncan Sommerville and Robert R. Blackburn 9 Oct. 1964 81 p
(Contract NAS8-11012; MRI Proj. 2715-P)
(NASA-CR-62200) CFSTI: HC $2.00/MF $0.75

Four computer programs written for the IBM 7094 are described, which have the following purposes: Program A—find indicial and impulsive missile responses; Program B—perform a Duhamel integration to find responses to actual wind profiles; Program C—plot and analyze results of Program A; and Program D—plot and analyze results of Program B. Author

N65-21764*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS, VOLUME II
R. Sridhar, G. C. Agarwal, R. M. Burns, D. M. Detchmendy, E. H. Kopf, Jr. et al Jan. 1965 108 p Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-62243; TR-EE65-4) CFSTI: HC $4.00/MF $0.75

Listings of the computer programs used in solving various example problems are presented. Explanations are given at the beginning of each appendix concerning the programs contained therein; descriptions of the general makeup of the programs and their interrelations are provided. Author

N65-21785# California Univ., Livermore. Lawrence Radiation Lab.
A FORTRAN PROGRAM FOR THE NUMERICAL SOLUTION OF THE SCHRODINGER WAVE EQUATION
George Wilcox 1 Feb. 1965 13 p refs
(Contract W-7405-ENG-48)
(UCRL-12343) CFSTI: $1.00

The ONDE is a program designed to numerically solve the Schrödinger wave equation with complete screened Coulomb potential. The code can readily be altered to solve any radially symmetrical potential. With minimal changes in the boundary conditions, the Coulomb potential

$$V(r) = -Ze^2/r$$

has been solved. The numerical solution is an explicit scheme with

$$S(\rho)_{j+1} = (S\rho)_j + m_j\Delta\rho$$

$$m_{j+1} = m_j + \Delta m_j$$

$$\int_1^J \rho_j^2 S(\rho)_j^2 d\rho.$$ Author

N65-22051# RAND Corp., Santa Monica, Calif.
SPECTRAL ANALYSIS OF TIME SERIES GENERATED BY SIMULATION MODELS
George S. Fishman and Philip J. Kiviat Feb. 1965 79 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4393-PR; AD-612281)

This study applies spectral analysis to the study of time series generated by simulated stochastic models. As these data are autocorrelated, analysis by methods applicable to independent observations is precluded. Mathematical models known as covariance stationary stochastic processes are useful representations of autocorrelated time series. The increased publication of literature describing stochastic processes and spectral analysis, in particular, is making these ideas available to an increasing audience. Section I presents a rationale for our interest in time series models and spectral analysis. Section II describes the basic notions of covariance stationary processes. It emphasizes the equivalence of looking at these processes in both the time and frequency domains; the compactness of frequency domain analysis seemingly recommends it over correlation analysis. Section III provides a heuristic background for understanding statistical spectral analysis. Simple frequency-domain statistical properties are emphasized and compared with the rather involved sampling properties of estimated correlograms. Several relevant statistical tests are described. Three simulated experiments are used as examples of how to apply spectral analysis. These are described in Sec. IV. TAB

N65-22124*# American Univ., Washington, D. C. School of Government and Public Administration
A REVIEW OF THE FIELD OF ARTIFICIAL INTELLIGENCE AND ITS POSSIBLE APPLICATIONS TO NASA OBJECTIVES Final Report
M. J. Pedelty Feb. 1965 19 p refs
(Contract NASr-229)
(NASA-CR-62346) CFSTI: HC $1.00/MF $0.50

A synopsis of a study on the design of control systems, data-gathering systems, and data-analyzing systems is presented which focuses on the possibility of using automatic control in place of human control systems. General theoretical considerations such as language theory, automata theory, information theory, systems theory, decision theory, and epistemology and ontogeny, are discussed in respect to their importance in the conception and design of control and data systems. The applicability of artificial intelligence systems to extended lunar exploration missions is discussed. S.C.W.

N65-22146# Columbia Univ., New York. Dept. of Electrical Engineering
SOME NETWORK INTERPRETATIONS OF SYSTEM PROBLEMS
Thomas E. Stern Dec. 1964 88 p refs
(Contract Nonr-4259(04))
(TR-82; AD-611804) CFSTI: $3.00

Certain special properties are set forth of network-S which can be exploited in synthesizing network analogs for two basic types of extremum problems. On the one hand, the fact that the equilibria of resistive reciprocal networks can be identified with stationary points of their associated dissipation functions leads in a natural way to the construction of network analogs for mathematical programing problems. On the other hand, the fact that Lagrangian networks behave in such a manner as to make a certain functional stationary leads to the formulation of networks which generate extremals for variational problems. It should be emphasized that these analogs are meant simply as network interpretations of extremum

problems. The actual use to which they are put must depend upon the inclination of the individual, and on the particular problem being analyzed. Among their possible uses are, (1) as a heuristic tool to promote a better "physical" understanding of a problem, (2) as a means of suggesting more efficient computational schemes for solving extremum problems, and (3) as a direct analog to be used either alone or in conjunction with other devices for the solution of an extremum problem. Author

N65-22148# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS TECHNOLOGY. IV: DESCRIPTIONS OF THE MN-11, MN-M, AND MN-7 ANALOG COMPUTERS AND OF THREE MISCELLANEOUS ELECTRONIC DEVICES
Wade B. Holland ed. Feb. 1965 26 p refs Transl. into ENGLISH from RUSSIAN
(Contract AF 49(638)-700; Proj. RAND)
(RM-4461-PR; AD-611307) CFSTI: $2.00

This memorandum is a collection of translations detailing technical specifications of the MN-11, MN-M, and MN-7 Soviet analog computers, and of the BPZ-1 fixed-delay unit, the I-5 CRT indicator, and the VPRR-2 electronic device for controlling tooling modes. The material was collected and translated at the Rand Corporation as part of an effort to maintain an awareness of current developments in the Soviet computer field. TAB

N65-22169*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
COMPUTER SOLUTIONS OF THE VLASOV EQUATIONS Final Report, Jun. 1, 1963–Nov. 30, 1964
D. C. Prince, Jr. and N. P. Jeffries 30 Dec. 1964 255 p refs
(Contract NAS8-5214)
(NASA-CR-62344) CFSTI: HC $6.00/MF $1.25

This is the final report of the program Computer Solutions of the Vlasov Equations. Computer programs were written to determine solutions of the Vlasov equations for plane, cylindrical and spherical geometries. Potential distributions and charge density distributions were found for each of these configurations under a range of conditions. Values of the independent parameters of bias potential, electrode spacing (in Debye lengths), and charge density ratio, were chosen so as to yield a wide variety of types of solutions. The fundamental physical characteristics of each of these systems were established. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-21173# Silicon Transistor Corp., Carle Place, N. Y.
PRODUCTION ENGINEERING MEASURE TO INCREASE THE RELIABILITY OF THE TRANSISTOR TYPE 2N2034 Quarterly Progress Report, 1 Oct.–31 Dec. 1964
A. Palmerini [1964] 22 p
(Contract DA-36-039-AMC-01482(E))
(QPR-6; AD-613214)

The military specification of the Transistor Type 2N2034 was approved. Results of operating life and some environmental tests showed excellent stability in device parameters. Author

N65-21175# Tung-Sol Electric, Inc., Bloomfield, N. J. Electron Tube Div.
ELECTRON TUBES RADIATION RESISTANT PILOT LINE PRODUCTION Quarterly Progress Report, 1 Sep.–30 Nov. 1964
John F. Grimm 31 Dec. 1964 62 p
(Contract DA-36-039-AMC-01476(E))
(QPR-6; AD-612658)

High temperature life testing (500° C bulb temperature) was concluded on 6080WB Alumino-Silicate tubes, 21 having successfully completed 500 or more hours of operation. Testing of Alumino-Silicate 6360 tubes was discontinued owing to premature life failure of the entire lot. The 1000-hour steady-state nuclear radiation exposure test was completed on both conventional and alumino-silicate tubes of all four types. The irradiated tubes are still too radioactive to test. Thermal shock and moisture resistance tests were run successfully on representative tubes of all four types, in both conventional and alumino-silicate glass. The pulsed radiation exposure test was revised to provide additional information. New approaches are being attempted in an effort to improve the low yield on 5886 and 6205 types meeting initial electrical characteristics. Both of these tubes are running 85% to 90% shrinkage. Radical departures from the present design are being followed in order to eliminate low emission. Author

N65-21187# Weapons Research Establishment (Australia).
THE NUMERICAL CALCULATION OF THE CHARACTERISTIC IMPEDANCE, PROPAGATION CONSTANT AND THE EQUIVALENT CIRCUITS OF OBSTACLES IN T.E.M. MODE TRANSMISSION LINES
H. E. Green Dec. 1964 65 p refs
(WRE-PAD-14)

A generalized numerical solution is described of Laplace's equation in two dimensions subject to boundary conditions imposed by conducting surfaces and dielectrics, which are permitted a limited amount of inhomogeneity. It is shown how these solutions may be applied in the determination of the properties of T.E.M. mode transmission lines including the equivalent circuits of simple obstacles in these lines. The theory is illustrated with a number of examples. Some of the examples given are purely illustrative of the power of the technique, others, such as step discontinuities in coaxial lines, are given a very detailed treatment with the production of considerable design data. Author

N65-21193# Royal Aircraft Establishment, Farnborough (England).
A NANOSECOND PULSE GENERATOR AND SHAPING CIRCUIT WITH AVALANCHE TRANSISTORS [GENERATEUR D'IMPULSIONS NANOSECONDE ET CIRCUIT DE MISE EN FORME A TRANSISTORS AVALANCHE]
J. J. Samueli, A. Sarazin, and J. Guyon London, Min. of Aviation, Dec. 1964 14 p refs Transl. into ENGLISH from Nucl. Instr. and Methods (France), v. 26, 1964 p 71–76
(RAE-LIB-TRANS-1085)

A pulse generator which operates at high continuous repetition rates and produces rectangular or exponential pulses is described. The circuit is all solid state and uses an avalanche transistor. At 5 Mc/s the pulse width is adjustable

from 2 to 10 nsec with a 0.5 nsec rise time and the pulse amplitude is 8 V across 50 ohms. At 25 Mc/s exponential pulses are produced with 1 nsec rise and 15 nsec fall times. Author

N65-21196# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RESEARCH AND DEVELOPMENT ON PHOTOCONDUCTIVE PHOTO-TAPE Interim Report, Aug. 1–Oct. 30, 1964
F. J. Bingley, S. Gray, E. Levin, T. H. Moore, and P. C. Murray
Dec. 1964 70 p refs
(Contract AF 33(657)-11485)
(IR-4; AD-609768)

Investigations in phototape, photoconductor, electron-gun, and camera design and operation are reported. The application of feedback to the readout process of a phototape camera study led to the conclusion that there does not appear to be any advantage to be gained from the use of negative feedback in the readout structure. Further, the advantages to be gained from the use of positive feedback do not appear to be great when compared with the difficulties encountered. An evaporator to produce an aluminum barrier layer for mixed-selenide tapes was developed. This evaporator will fit into the tape machine when it is modified for single-pumpdown operation. Data on the bearings tests are also tabulated. Since sufficient life data have been obtained to show adequate life, bearing tests have been terminated. Spectral response for a cell with $1As_2Se_3 \cdot 1Sb_2Se_3$ photoconductor and the relative photocurrent as a function of light intensity of this photoconductor with different electrode materials are reported. E.E.B.

N65-21239# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 168
Hsieh-T'ing Ling et al 9 Apr. 1965 62 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-29516; TT-65-30696) CFSTI: $3.00

CONTENTS:

1. TRANSISTOR CIRCUIT DESIGN Hsieh-T'ing Ling p 1–16 refs
2. TELEVISION Ch'ing-yen Chang p 17–35
3. SEVERAL PROBLEMS OF SINGLE SIDE BAND TRANSMITTERS RELATED TO ENVELOPE Shang-p'ing Ch'ien p 36–40 refs
4. PROBLEMS ON FREQUENCY-SHIFT TELEGRAPHY Ch'i Wang p 41–42 refs
5. OBLIQUE INCIDENCE DETECTING METHOD AND ITS APPLICATION OF SHORT WAVE BACK-SCATTERING Chen-yuan Ts'ai p 43–44 refs
6. QB306-TYPE 6-DIGIT ELECTRONIC FREQUENCY COUNTER Chuan-Hsun Ch'iu p 45–49
7. FIRST ANNUAL MEETING OF KIANGSU PROVINCIAL ELECTRONICS SOCIETY Chi-shu Tien-tzu p 50
8. USE OF MODERN SCIENTIFIC METHODS IN STUDY OF CHINESE TRADITIONAL MEDICINE Hsin-chung Chien p 51–56
9. CHINESE NUMERICAL FORECAST SERVICE p 57–61 refs

N65-21334*# Resdel Engineering Corp., Pasadena, Calif.
TV TRANSMITTER-EXCITERS AND POWER AMPLIFIERS Progress Report, 1, Nov.–1 Dec. 1964
A. G. Van der Capellen 15 Dec. 1964 19 p
(Contract NAS8-11609)
(NASA-CR-57902; PR-5) CFSTI: HC $1.00/MF $0.50

Measurement of sine-squared pulse degradation and sweep (or multiburst) signal in obtaining information about high frequency video response is described; specification of the video system being developed calls for a modulation index of 6 at 1 Mc and of 1 at 6 Mc which is equivalent to a flat response up to 6 Mc. The sine-squared pulse reflects the presence of overshoot or ringing, and the sweep signal determines whether the bandwidth is within certain limits. A block diagram of the TV transmitter is included. Equations in harmonic analysis of the effect of a band-pass filter on an FM signal are given. Fourier analysis is presented for sine-squared pulse in frequency modulation, and for the effects of a band-pass filter on sine-squared pulse of specified half amplitude duration. J.M.D.

N65-21387*# Sperry Rand Corp., Blue Bell, Pa. Univac Research Operations
MINIATURE SPACE-BORNE MEMORY Monthly Technical Report No. 2, Jan. 4–31, 1965
G. A. Fedde 9 Feb. 1965 6 p
(Contract NAS5-9518)
(NASA-CR-62100) CFSTI: HC $1.00/MF $0.50

High-temperature tests were made on a number of adhesives which had been considered for use in the construction of the memory stack. These tests showed that the adhesive systems were not satisfactory for 48-hour storage at 150° C. New adhesive systems will be tested. Additional protective metallic platings over the magnetic thin-film plated wire will be tested. In addition to the tin plating now undergoing life tests, gold, rhodium, and cadmium platings will be tested. Author

N65-21402# Eitel-McCullough, Inc., San Carlos, Calif.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 8, Jul. 1–Sep. 30, 1964
William R. Luebke and Tore Wessel-Berg 30 Nov. 1964 37 p
(Contract AF 30(602)-2756)
(RADC-TR-65-14; AD-612911)

The purpose of this program is to develop a klystron amplifier operating at 8 kMc and delivering 1 MW of CW power. After its 4-hour acceptance test at the 110 kW average power level, the second long pulse tube was operated CW at 350 kW. Waterload arcing prevented stable operation but no damage to the tube occurred. The first of the multiport tubes was processed and placed on initial test at low average power. Several additional transmission windowtrons were fabricated and tested. An analysis of power flow in coupled cavities is presented. Author

N65-21405# Texas Instruments, Inc., Dallas. Semiconductor Research and Development Lab.
PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 1, 30 Jun.–30 Sep. 1964
Charles L. White, W. P. Waters, and R. L. Petritz [1964] 79 p
(Contract DA-36-039-AMC-03632(E))
(TI-03-64-73; AD-612617)

The L-78 geometric pattern was used to fabricate germanium planar transistors. The process flow used in fabricating the L-78 planar epitaxial germanium diffused-base transistor is described. Pictorial cutaway views of the transistor structure, corresponding to appropriate operations, are shown. The intrinsic f_T of planar devices was approximately 1600 Mc compared to 2050 Mc for a mesa device of comparable design using similar fabrication techniques. The intrinsic f_T of planar devices was increased to equal that of the mesa by

optimizing the composition of the emitter material. The L-78 planar devices fabricated exhibit minimum noise figure at 1.0 Gc of 4.5 to 5.5 dB at approximately 1.5 mA of emitter current while peak f_T occurs at approximately 5.0 mA. A modification of the L-78 pattern, designated L-78A, via emitter area reduction from 0.76 mil^2 to 0.27 mil^2 manifested itself by a shift in peak f_T toward lower values of emitter current. The purpose of this modification is to bring into registry the peak gain of the device and minimum noise figure at one particular bias level. The materials used for the base stripes of the planar unit were optimized to provide good ohmic contact to germanium. Author

N65-21411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF DESIGNING AMPLIFYING INSTRUMENT OF SHF AND ARRANGEMENT OF TRAVELING-WAVE TUBES FOR ACCOMPLISHING IT
V. A. Bunin and R. I. Raykhlin 16 Mar. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 132724 (Appl. No. 651264/26, Jan. 18, 1960) 2 p
(FTD-TT-64-558/1+2; AD-612782)

Object of the invention: (1) Method of designing amplifying instruments of superhigh frequency which are distinguished by the fact that for the purpose of increasing their period of service, instead of an electron beam for interaction with an electromagnetic wave, there is used a superconductor with a current. (2) A device of traveling-wave tubes for accomplishing the method described in paragraph (1), which is distinguished by the fact that in the center of the moderating system there is placed a superconductor in the form of a thin layer of metal on a dielectric tube cooled by liquid helium. TAB

N65-21437# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON ELECTROTECHNOLOGY [LITERATUUROVERZICHT, ELECTROTECHNIEK]
21 Jan. 1965 27 p refs In DUTCH *Its* 14th Yearly Issue, No. E-456

A short annotated literature review on electrotechnology is presented pertaining to the following topics: *Telecommunications; Electromagnetic Beaming; Treatment of Information; Computers and Logical Switches; Measurement and Regulating Techniques; Miniaturization; Interference and Reliability; Oscillators and Strengtheners; Components, Materials, and Networks; Modulation; Energy Techniques, Feeding, Equalizing, and Machines;* and *Miscellaneous.* G.G.

N65-21500# Du Mont (Allen B.) Labs., Inc., Clifton, N. J. Tube Div.
PROGRAM TO DEVELOP A 12 INCH DIAMETER FIBER OPTIC FACEPLATE CATHODE RAY TUBE Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Madison Cawein 20 Nov. 1964 11 p
(Contract NObsr-91206)
(QPR-1; AD-609967)

The basic and component designs were completed. The electron gun design was evaluated for possible difficulties in manufacture, and a method for pretesting the electron guns was developed. Author

N65-21512# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RELAY DEVICE
Manfred Liske 18 Jun. 1963 6 p Transl. into ENGLISH from Soviet Patent No. 144553 (Appl. No. 728146/24-7, 26 Apr. 1961) p 1–4
(FTD-TT-63-499/1+2; AD-411392)

A square pulse forming block, made with a trigger arrangement with semiconductor triodes, is described. The trigger return coefficient is improved by connecting a controllable resistance in the emitter circuit. Also, the coincidence unit uses a semiconductor triode with one input fed to the base of the triode through a differentiating RC link, and another fed directly to the collector. The output signal is taken from the emitter junction. In order to elongate the pulses, a monostable trigger (monovibrator) is connected to the output of the coincidence unit. Sketches of the device are included. E.E.B.

N65-21669*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON OF BURN-IN AND BAKE AS SEMICONDUCTOR SCREENING TECHNIQUES FOR THE NIMBUS SPACECRAFT PROGRAM
Irving J. Ross Mar. 1965 49 p refs
(NASA-TM-X55206; X-650-65-105) CFSTI: HC $2.00/MF $0.50

This report summarizes and compares the relative effectiveness of high-temperature storage (bake) and high-temperature operating burn-in as screening techniques for semiconductor devices used in the Nimbus spacecraft program. Data were accumulated from summaries of burn-in and bake screening. Results are presented for 162 different types of semiconductor devices, with an overall sample size of 70 300 for an aggregate of 49 million device hours for both screening techniques. Results indicate that burn-in is superior to bake for every class of semiconductor device and for every manufacturing process used in the fabrication of the devices. Correlation is shown between rated power dissipation and burn-in effectiveness. Statistical significance of the data is evaluated when comparability of types is possible, i.e., where the types were both burned-in and baked. Author

N65-21686 Radio Corp. of America, Lancaster, Pa.
DEVELOPMENTS IN ELECTRON OPTICS PRODUCE TWO NEW LINES OF VIDICON TUBES
Robert G. Neuhauser *In* RCA, Burlington, Mass. Electro Optics 1964 p 49–51 refs (See N65-21675 11-14)

A major development program is aimed at revising the electron optical system of the magnetically deflected, magnetically focused vidicons. This program has led to two new series of vidicons: (1) magnetically focused, magnetically deflected, with an internal electrostatic collimating lens, and (2) electrostatically focused, magnetically deflected. Author

N65-21763*# Electro-Mechanical Research, Inc., Princeton, N. J.
INVESTIGATION OF DARK CURRENT IN ASCOP 541F MULTIPLIER PHOTOTUBES AFTER EXPOSURE TO HIGH LIGHT LEVEL Final Report, 23 Oct.–23 Dec. 1964
[1964] 33 p refs
(Contract NAS5-9089)
(NASA-CR-62242) CFSTI: HC $2.00/MF $0.50

Tests have been performed on eight ASCOP 541F multiplier phototubes over a wide range of high light-level exposure conditions to determine the time-dependent behavior of the dark current after such an exposure. The mechanism proposed for this misbehavior of the dark current is the thin-film field emission (Malter effect). Several methods for suppressing this effect have been proposed. Author

N65-21782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

X-RAY IMAGE BRIGHTNESS AMPLIFIER WITH DIMENSION OF 190 MM (PROBLEM OF AN ELECTRON-OPTICAL SYSTEM)

V. Jares and B. Novotny 4 Feb. 1965 23 p refs Transl. into ENGLISH from Slaboproudy Obzor (Prague), v. 25, no. 1, 1964 p 11–17
(FTD-TT-64-915/1+2; AD-457870)

The principle of an X-ray image brightness amplifier is described, a brief theory is given of the electrode system with spherical field, and experimental results are given on increasing the distance of image level. Also described is an experimental method to determine the illustrating properties of an electrode transmission system, and results are given for measuring when planning an electrode system of X-ray image amplifiers with useful dimension of photocathode of 190 mm. Author

N65-21833 Radio Corp. of America, Princeton, N. J. Microwave Research Lab.

MICROWAVE RESEARCH, DEVICES FOR THE FUTURE

Leon S. Nergaard *In* RCA, Camden Microwave Systems and Devices [1964] p 21–23 refs (See N65-21828 11-07)

This discussion of the scope and trends in microwave research explores the future of microwave by examining the present state-of-the-art and problems that must be solved, and by examining the historical trends of earlier research. Information on current projects is included, and compared with that of two years ago. Author

N65-21834 Radio Corp. of America, Princeton, N. J. RCA Labs.

RECENT RESEARCH ON LOW-NOISE TRAVELING-WAVE TUBES

Stanley Bloom *In* RCA, Camden Microwave Systems and Devices [1964] p 24–25 refs (See N65-21828 11-07)

The low-noise traveling-wave tube is a microwave receiving tube possessing broad bandwidth, high gain, and good stability—all without sacrifice of sensitivity. These tubes find application in military radar and missile guidance systems as well as in telemetry and commercial radio-relay systems. This paper emphasizes noise-reduction research, which has resulted in the lowest TWT noise figures yet obtained. Author

N65-21835 Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.

LOW- AND MEDIUM-POWER TRAVELING-WAVE TUBES AS VERSATILE BROADBAND MICROWAVE AMPLIFIERS, A REVIEW

H. J. Wockstein, R. W. Mc Murrough, and G. Novak *In* RCA, Camden Microwave Systems and Devices [1964] p 26–31 refs (See N65-21828 11-07)

The exceptional capabilities of this tube in comparison to conventional microwave amplifiers are pointed out, the operation of the tube is briefly explained, and the major applications and the environmental capabilities of the device are described. The emphasis is on the exceptional versatility of this tube which has resulted in its extensive use as a microwave-systems amplifier in communications, radar-surveillance, electronic-countermeasures, and a variety of other complex microwave applications. Author

N65-21836 Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.

MINIATURE C-BAND SOLID-STATE FREQUENCY MULTIPLIER FOR MISSILES

J. J. Napoleon, D. E. Nelson, and C. L. Cuccia *In* RCA, Camden Microwave Systems and Devices [1964] p 32–37 refs (See N65-21828 11-07)

A rugged, miniaturized, all-solid-state harmonic generator especially designed to operate under the adverse environmental conditions encountered in missile applications is described. The harmonic generator is a module, 26 $in.^3$ in volume, which accepts power in the 30- to 40-mW range at 104 Mc, amplifies this power to approximately 8 W, and then harmonically converts the frequency by a factor of 48 to 5000 Mc. At this frequency, a power output in excess of 400 mW is obtained over the temperature range from 0° to 75° C with minimal white-noise contributions in the vicinity of the output frequency. Author

N65-21837 Radio Corp. of America, Princeton, N. J. Electronic Components and Devices

MICROWAVE TUNNEL-DIODE AMPLIFIERS AND OSCILLATORS

D. E. Nelson, A. Presser, E. Casterline, and R. M. Minton (RCA, Somerville, N. J.) *In* RCA, Camden Microwave Systems and Devices [1964] p 38–41 refs (See N65-21828 11-07)

The characteristics required of tunnel diodes for efficient use in microwave amplifiers and oscillators are discussed. The development of suitable diodes for specific devices—a C-band tunnel-diode amplifier and an L-band tunnel-diode oscillator—is described. The general design requirements and the problems encountered in the development of these devices are explained. A circuit description and approximate expressions for gain, bandwidth, and noise figure of tunnel-diode amplifiers are given. The effects of variations in the supply voltage, temperature, and load on the frequency stability of tunnel-diode oscillators are considered. Author

N65-21839 Radio Corp. of America, Princeton, N. J. RCA Labs.

ELECTRON-BEAM–PLASMA AMPLIFIERS: A FUTURE IN MILLIMETER-WAVE AMPLIFICATION

G. A. Swartz *In* RCA, Camden Microwave Systems and Devices [1964] p 46–48 refs (See N65-21828 11-07)

Possible methods of efficient coupling of millimeter wave power to a beam–plasma system are described. One method uses a strong magnetic field, and the other utilizes a tubular plasma geometry. Electron beam–plasma amplifiers show promise of providing the amplification and generation of millimeter and submillimeter waves. The gain per unit length in these amplifiers is very high because of the close proximity between the electron beam and plasma. However, the power output is noisy because of beam electron collisions with the plasma particles. Plasmas with sufficient density and ionization were produced, for use in the amplifier. Electron beam densities greater than 5000 amp/cm^2 must still be developed to increase the efficiency of the amplifier. L.S.

N65-21875# Magnavox Co., Fort Wayne, Ind.

QUARTZ CRYSTAL OSCILLATOR CIRCUITS DESIGN HANDBOOK

D. Firth 15 Mar. 1965 522 p refs
(Contract DA-36-039-AMC-00043(E))
(TP64-1072; AD-460377)

The object of this handbook is to assemble a set of design methods for crystal oscillators in the frequency range of 1 kc to 200 Mc with the aim of facilitating design, eliminating crystal unit misapplications, and reducing design costs. The handbook is not directed at the design of ultrastable crystal

oscillators, but rather at the nontemperature controlled, medium frequency stability oscillator commonly in use in many types of communications equipment. The handbook contains discussions of (1) the electrical characteristics of crystal units, conditions of usage, and methods of measurement, (2) characteristics of tube and transistor amplifiers, (3) characteristics of impedance transforming networks, (4) detailed design information on series resonance and antiresonance oscillators, and (5) design examples together with experimental evaluation data covering most of the 1-kc to 200-Mc range. Author

N65-21932# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 19, Oct.–Dec. 1964
C. T. Schmidt et al [1964] 22 p refs
(Contract W-7405-ENG-48)
(UCRL-12378) CFSTI: $1.00

Five topics on radiation hazard control are discussed as follows: (1) *Comparative Background Characteristics of RCA Type 8054 and C70145 Photomultipliers*—comparative and absolute background measurements of the developmental type-C70145 photomultiplier are given; (2) *Whole Body Counter* Accomplishments—calibration methods for Cs^{137} and average results of analysis for Cs^{137} and potassium are presented; (3) *Protection of Personnel Monitoring Films From High Humidity*—experiments show that 0.005-inch polyethylene jackets provide adequate protection for personnel monitoring film exposed to high humidity; (4) *Preliminary Investigations of the Slit Draped Hood Concept for Control of Moderate to High Hazard Operations*—A slit draped hood was devised to provide protection when neither a glove box nor an open hood is entirely adequate; and (5) *Evaluation of Demisters as High Expansion Foam Arresters*—the demisters were found to be extremely ineffective for arresting high expansion foam. R.W.H.

N65-21937 United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
A SIMPLE METHOD FOR DETERMINING REFLECTED PULSES DUE TO IMPERFECT CABLE TERMINATIONS
M. O. Deighton Dec. 1964 10 p ref
(AERE-M-1465) HMSO: 1s 9d

A simple equivalent circuit is presented which simulates a mismatched cable termination. Using this, the output waveform resulting from an incident pulse or transient can be determined and the reflected signal then follows by subtraction of the incident one. Illustrative examples include simple cases as well as one where multiple reflections occur at both ends of a cable. Author

N65-22013# Utah Univ., Salt Lake City. Dept. of Electrical Engineering
CYCLOTRON WAVE DEVICES STUDY Sixth Quarterly Progress Report, Oct. 1–Dec. 31, 1964
T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow [1964] 46 p
(Contract DA-36-039-AMC-02372(E))
(Rept.-6; AD-460577)

The flat-cathode immersed-flow gun cyclotron-synchronous wave amplifier was tested with no improvement in the rf characteristics as contrasted to the results for the convergent-gun tube. It appears that some detuning may be present in the amplifier section due to magnetic field perturbations. The cyclotron-wave power converter was operated successfully at high voltage levels and at microwave power levels up to 1 watt. A new depressed collector design is working well, and efficiencies of the order of 50% have been obtained. Author

N65-22044# Varian Associates, Beverly, Mass.
THALLIUM BEAM TUBE RESEARCH First Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Richard F. Lacey and Joseph H. Holloway [1964] 36 p refs
(Contract DA-28-043-AMC-00350(E))
(Rept.-1; AD-456847)

A workable apparatus to test hot wire ionizers has been completed. The cylindrical cavity design has been shown to be a practical, workable cavity to build and use. Using mode filters to support the central rod lowers the Q and can make cavity mode characteristics more complicated; supporting it by an uncoated continuation shielded from the atomic beam seems preferable. Circular breaks in the conducting coating of the cavity cylinder are effective in suppressing unwanted modes. It is feasible to build thallium beam tubes of reasonable dimensions with a performance better than current cesium beam tubes. A frequency stability $\Delta f/f = 0.85 \times 10^{-11}$ could readily be achieved given a reasonable detector efficiency in a beam tube about 17 in. long with a 1-cps noise bandwidth in the control circuit. Author

N65-22114# Joint Publications Research Service, Washington, D. C.
A FERRITE SPHERE IN A COAXIAL WAVEGUIDE
V. V. Maslennikova 27 Apr. 1965 15 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 4, Apr. 1964 p 616–624
(JPRS-29774; TT-65-30829) CFSTI: $1.00

The problem concerning a magnetized sphere and a self-consistent TEM wavefield in a coaxial waveguide is solved. The coefficients of transmission and reflection in an infinite and shorted coaxial waveguide containing a ferrite sphere are determined. These coefficients are also determined into crossed waveguides which are coupled by means of a ferrite sphere. The results obtained by calculation and experiment are compared. Author

N65-22130*# Westinghouse Electric Corp., Baltimore, Md. Electronic Tube Div.
STUDY OF THE DESIGN PROBLEMS OF AN INTEGRATING TELEVISION TUBE FOR ASTRONOMICAL RESEARCH Final Report
Dec. 1964 165 p refs Prepared for Princeton Univ. Obs.
(Grant NsG-414)
(NASA-CR-62303) CFSTI: HC $5.00/MF $1.00

Three main applications of the integrating image tube to astronomical studies are considered. Stellar spectrophotometry, photometry of extended sources, and binary resolution–faint point sources are listed in order of importance for the study. Absorption spectra of low contrast are to be expected from faint stars. Spectra in the wavelength range of 1200 to 6000 Å are of primary interest, although the 900 to 1200 Å range is also desirable. The application of photometry of extended sources generally involves low-contrast signals but may also have a bright point source with a low-contrast surroundings. With the binary resolution–faint sources, the relative position of two faint sources, or a faint and a bright source, is of interest as well as any intensity fluctuations of these sources. The goal of any imaging tube used in these applications is its ability to measure 400 photoelectrons/image element with an accuracy of 10%. E.E.B.

N65-22134*# Fairchild Camera and Instrument Corp. Syosset, N. Y. Systems Management and Engineering Dept.
SATURN SWITCH SELECTOR. PHASE II: COMPLETION REPORT
T. Palamenghi and C. Rasmussen 12 Mar. 1965 72 p
(Contract NAS8-11683)
(NASA-CR-62294; SME-AK-8) CFSTI: HC $3.00/MF $0.75

A breadboard containing the control logic circuitry, magnetic core input register, steady-state register and three representative decode and output channels was fabricated. Tests were conducted over the extremes of temperature and supply voltage profiles. The results of the breadboard evaluation task are discussed. A complete packaging design has been generated, containing the finalized system circuitry developed through breadboard analysis. The overall packaging concept and the specific techniques utilized are discussed. The report concludes with a comprehensive reliability analysis of the finalized system. Author

N65-22136# Library of Congress, Washington, D. C. Aerospace Technology Div.
RADIATION EFFECTS Surveys of Soviet-Bloc Scientific and Technical Literature, 1960–1963
24 Mar. 1965 107 p refs
(ATD-P-65-12; AD-460799) CFSTI: HC $4.00/MF $0.75

A survey of recent studies on radiation damage to electronic components and materials as reported in Soviet open literature is presented. The survey is organized into four broad categories: semiconductors, which emphasize the theoretical aspects of radiation effects; dielectrics, which emphasize experimental techniques; radiation effects in ferrite; and radiation effects in discrete components. An extensive list of references accompanies the survey. S.C.W.

N65-22142# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
NON-VACUUM DEPOSITION TECHNIQUES FOR USE IN FABRICATING THIN FILM CIRCUITS Interim Engineering Report No. 2, 1 Oct.–31 Dec. 1964
15 Jan. 1965 48 p refs
(Contract NObsr-91336)
(AD-456793)

The causes of instability of gas-plated tin oxide resistors were investigated. The nature of the ambient tin oxide interface was found to determine the electrical properties of thin resistor films. High temperature stress test has shown that protection of the tin oxide interface by an encapsulating dielectric film is successful in stabilizing the electrical properties of the thin film resistors. A method for the delineation of tin oxide resistors and other hard to etch materials is described. Vapor-deposited dielectric films of tantalum oxide and tantalum oxide–aluminum oxide were prepared and their electrical properties investigated. Tantalum oxide–aluminum oxide films have dielectric constants in the range 20 to 25. Capacitors using this dielectric film have been prepared with a Q in excess of 200 at 1 kc and a capacitance of 1 pf/mil^2. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-21160*# Martin Co., Baltimore, Md.
A GUIDE OF THE APPLICATION OF THE LIAPUNOV DIRECT METHOD TO FLIGHT CONTROL SYSTEMS
Eugene J. Lefferts Washington, NASA, Apr. 1965 189 p refs
(Contract NAS2-1777)
(NASA-CR-209) CFSTI: HC $5.00/MF $1.25

The application of the Liapunov direct method to flight control systems is discussed. The main concepts of the direct method are presented without proofs as follows: (1) required matrix, background, and major transformations by which vector systems may be put into the standard state vector form for subsequent analysis; (2) stability definitions and the second method of Liapunov; (3) construction of Liapunov functions; (4) classical problem of Lur'e; (5) Lagrange stability, boundedness, and time-varying systems; (6) discrete systems; and (7) optimal and adaptive control theory and the second method. The second method of Liapunov is a powerful tool of analysis and bears close ties with modern control theory, but it has serious difficulties when applied to realistic problems. These deficiencies result from the inability to construct optimal functions for determining regions in the parameter space which insure stability, and the inability to relate to these functions qualitative design goals. E.E.B.

N65-21312*# Microwave Electronics Corp., Palo Alto, Calif.
INVESTIGATION OF SOLID STATE TRAVELING-WAVE AMPLIFIER TECHNIQUES FOR FUTURE SATELLITE APPLICATIONS Monthly Progress Report No. 5, 1–31 Jan. 1965
V. R. Johnson and F. A. Olson [1965] 6 p
(Contract NAS5-3972)
(NASA-CR-57796) CFSTI: HC $1.00/MF $0.50

Apparatus required for making good acoustic bonds operable in the kilo-megacycle frequency range, and for bonding buffer crystals to the amplifier crystal were designed and fabricated. The CdS crystals were lapped and polished and the Z-cut quartz bars to be used as buffer crystals were readied for the vacuum station. Three optimum materials were selected which have good characteristics—CdSe, CdS, and ZnO. Of these, CdS and CdSe are commercially available. ZnO is not available in the desirable resistivity range. Also, shear-wave transducers were fabricated and successfully tested. E.E.B.

N65-21361# Joint Publications Research Service, Washington, D. C.
AUTOMATIC THRESHOLD CONTROL
E. M. Gadidulin and N. I. Pilipchuk 13 Apr. 1965 11 p refs
Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, no. 2, 1965 p 228–234
(JPRS-29552; TT-65-30715) CFSTI: $1.00

The principle of automatic threshold control is considered for the case in which the state of the signal at the time is known. The probability distribution of the threshold of an established signal is found. It is shown that the average value of the threshold is asymptotically equal to a value determined from a condition of equality of a false alarm and admission of the signal. A block diagram is presented of an apparatus performing control. An estimate is given of time of establishment. Author

N65-21456*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS, VOLUME I
R. Sridhar, G. C. Agarwal, R. M. Burns, D. M. Detchmendy, E. H. Kopf, Jr. et al Jan. 1965 270 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-62195; TR-EE65-3) CFSTI: HC $6.00/MF $1.50

A mathematical model for a space vehicle was developed, along with a computer program which allows simulation of a space vehicle and its attitude control system on a digital computer. The optimal control theory is reviewed and an optimal control problem in which the control input is bounded are given. A technique for sequential, least-square estimates of the states of a system was developed, based on noisy measurements of possible nonlinear combinations of the states of the system. Use of these estimates in controlling the system is investigated. An additional approach to the solution of a specific optimal control problem by use of a min–max criterion for the optimization is presented. The Fortran programs used to demonstrate the various examples are included. G.G.

N65-21462*# Arizona Univ., Tucson. Nuclear Engineering Dept.
RESEARCH IN AND APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL, VOLUME II Semiannual Status Report, Sep. 1, 1964–Feb. 1, 1965
James L. Melsa and Donald G. Schultz Mar. 1965 165 p refs (Grants NsG-490; NSF-GP-2237)
(NASA-CR-62187) CFSTI: HC $5.00/MF $1.00

The second method of Liapunov is used as a basis for developing a method of closed-loop time-optimal control of linear systems with bounded control norm. The second method is combined with the minimum principle in an optimization approach centering on a special class of solutions for the Hamilton–Jacobi equations. When these solutions, called eigenvector scalar products, are used for the control of systems in which the control matrix is nonsingular, it is possible to find surfaces which bound the optimal isochrones in an unusually simple manner. When the control matrix is allowed to be singular, it is no longer possible to develop a single method; effective suboptimal control is obtained by using the Bang–Coast method and the switched control method. Procedures are outlined for applying these suboptimal methods to some practical control problems, and two simple nuclear rocket control problems are used as illustrations. In each case, the method is shown to represent an effective compromise between system complexity and speed of response. M.P.G.

N65-21549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ALGEBRA OF LOGIC, LOGIC CIRCUITS, AND THEIR APPLICATIONS. 3: SEMICONDUCTOR DECODER CIRCUIT II FOR WATTS MIRROR INVERTED DECIMAL CODE
A. Agoston 22 Mar. 1965 16 p refs Transl. into ENGLISH from Meres es Autom. (Hungary), v. 11, no. 11, 1963 p 351–354
(FTD-TT-64-1207/1+2+3+4; AD-460457)

This article dealt with a binary-to-decimal converter or, in other words, with a decoder. With application of the algebra of logic, it deduces various possible logic circuits for the decoder, and then presents a semiconductorized circuit related to the simplified logic scheme. Measured data are given for one decade of the semiconductor decoder that was built. Author

N65-21559# Montana State Coll., Bozeman. Electronics Research Lab.
INVESTIGATION OF THE APPLICATION OF ITERATIVE NET THEORY TO CENTRAL NERVOUS SYSTEMS Final Report, Nov. 1963–Oct. 1964
W. L. Kilmer Oct. 1964 8 p
(Contract AF 19(628)-3807)
(ERL-8-0009-622; AFCRL-64-972; AD-612535)

Work concerning probabilistic automata and computer-simulation of a reticular formation model is briefly summarized. TAB

N65-21631*# National Aeronautics and Space Administration, Washington, D. C.
DYNAMICS OF DISCRETE AUTOMATIC CONTROL SYSTEMS CONTAINING CONSERVATIVE OR OSCILLATORY ELEMENTS [O DINAMIKE AVTOMATICHESKIKH SISTEM DISKRETNOGO UPRAVLENIYA, SODERZHASHCHIKH KONSERVATIVNYYE ILI KOLEBATEL'NYYE ZVEN'YA]
S. M. Fedorov Apr. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 5, 1964 p 93–99
(NASA-TT-F-9323) CFSTI: HC $1.00/MF $0.50

The stabilizing features of continuous systems containing conservative or moderately damped oscillatory elements are investigated. It is shown that a sufficient margin of stability can be insured by the introduction of a digital (pulsed) element into the system, whereas with continuous control the system is structurally unstable. The dynamics of discrete control systems is investigated by means of logarithmic frequency characteristics. Author

N65-21745# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A SURVEY OF METHODS FOR DIGITAL SIMULATION OF CONTROL SYSTEMS
W. D. Fryer and W. C. Schultz Jul. 1964 35 p refs
(CAL-XA-168-1-E-1)

An extensive study was made of the many methods of simulating system transfer functions and complete control systems, on a general-purpose, large-scale digital computer. In digital simulation, the fundamental problem is one of numerical integration; for the linear case, the desirable form is the recursive or difference equation form

$$y_n = a_0x_n + a_1x_{n-1} + \ldots + b_1y_{n-1} + b_2y_{n-2} + \ldots$$

where x's and y's are input and output sequences. Thus the problem becomes one of determining the coefficients a_i, b_i in the difference equation. Many methods for determining these coefficients exist, varying from the classical approach of numerical analysis to special z-transform approaches. The more important of these methods (e.g., the methods ascribed to Blum, Boxer–Thaler, Tustin, Madwed–Truxal) are evaluated, not only in a theoretical sense, but also by means of nontrivial, realistic numerical example; a critical review of each procedure is presented. Two special simulation techniques (DEPI and DYSAC) are also discussed. In these methods, the digital computer essentially simulates an analog computer, at least in the sense of the programing procedure. The same example mentioned above is solved using this type of approach, and an evaluation is given. Author

N65-22018# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
A COMPUTER PROGRAM FOR THE FREQUENCY ANALYSIS OF LINEAR ELECTRICAL NETWORKS
E. Allen Huber and Phyllis J. Grossberg 30 Oct. 1964 122 p
(Contract DA-36-039-AMC-03404(E))
(EDL-M752; AD-460160)

A computer program for performing frequency analysis of linear electrical networks with up to 40 nodes is described.

The network is described to the program by a list of the types of elements, their node connections and their values. The frequency functions to be calculated are defined by choosing from a prepared set of equations and listing the variables to be used in these equations. Subroutines are used to describe the frequency functions and transistor models; these subroutines may be easily changed to describe models or functions not presently provided. The desired frequency functions are computed in the program by generating the admittance matrix and partially inverting it to obtain the voltages needed in the specified equations. Author

N65-22025# Naval Civil Engineering Lab., Port Hueneme, Calif.
A COMPUTER APPROACH TO MAKING A FOURIER ANALYSIS OF DISTORTED POWER WAVEFORMS USING THE IBM 1620
John E. Rieber 28 Jan. 1965 35 p
(N-673; AD-457839)

The objective of this task is to determine the types of transients which exist in the primary commercial power supplied to naval installations having synchronous communication equipment. This report describes a computer program for the study of power line disturbances, using Fourier analysis. The mathematical background of the program and its operation are described in the report, using its possible application as an example. Detailed instructions for the use of the program are given. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-21165*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VERTICAL TEST RANGE FOR ANTENNA RADIATION MEASUREMENTS
John Steckel and William Korvin Washington, NASA, Apr. 1965 26 p refs
(NASA-TN-D-2752) CFSTI: HC $2.00/MF $0.50

To facilitate the measuring of satellite antenna radiation patterns in a controlled rf environment, the Vertical RF Test Range, an anechoic chamber for vhf radio waves, was devised. Of primary importance was the capability to absorb and/or suppress undesirable electromagnetic energy at frequencies as low as 125 Mc, which would normally be reflected by the chamber floor and walls. The satellite antennas of concern are of the broad-pattern, near-omnidirectional type. The preliminary study and scale model measurements indicated that a reflection coefficient of 20 to 25 dB can be expected in an electrically small chamber of $1\lambda \times 2\lambda \times 2\lambda$. Subsequent full-scale measurements have verified this. It was anticipated that the reflected energy level would decrease as the test frequency was raised, and this was borne out by scale model measurements. The dominant controlling factor at high frequencies is the structural weather protective radome. At the lowest frequency (125 Mc), the radome appears as a thin wall (about 0.05λ thick), but as the frequency is increased, the radome thickness becomes increasingly significant. Author

N65-21223 , Library of Congress, Washington, D. C. Aerospace Technology Div.
RECENT ADVANCES IN HYPERVELOCITY TECHNIQUE
Lee Boylan *In its* Foreign Sci. Bull., Vol. 1, No. 3 Mar. 1965 p 25-29 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

In recent hypervelocity research, much attention has been paid to techniques for launching projectiles at velocities above what has been described as the plateau velocity of 30 000 fps presently attainable with conventional light-gas guns. The three articles reviewed deal with novel approaches to this problem. The first two describe new methods for generating hypervelocity (90 to 100 km/sec) gas jets of high density, while the third describes an actual launcher based on similar principles. The material treated represents primarily the technical aspects of the facilities involved. Author

N65-21250# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
HIGH ENTHALPY SUPERSONIC WIND TUNNEL
J. M. Forde, A. M. Ahmed, and E. J. Szpiro Nov. 1964 31 p refs
(Grant DRB-G-9950-06)
(TN-64-9)

The design and construction of the high-speed, high-temperature wind tunnel; test section conditions and simulation capability; instrumentation; and experimental work are described. The pebble bed heat exchanger, nozzles, injectors, combustion tubes, and the vacuum system are discussed in detail. Test section conditions are determined by (1) the heat storage capacity of the pebble bed heat exchanger; (2) the vacuum system mass flow capacity; (3) the pressure ratio across the nozzle and the nozzle geometry; and (4) the test medium used. It is thus possible to obtain a wide range of conditions by changing these parameters in the test section. Typical values achieved with air as the test medium were: Mach 4; 3200° C total temperature; 750° C static temperature; 100 psia total pressure; 0.5 psia static pressure; 7480 ft/sec velocity; and 244 000 Re/ft. The experimental work has shown that supersonic combustion is feasible. E.E.B

N65-21264# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
PERFORMANCE ANALYSIS OF LEM INTERNAL ENVIRONMENT SIMULATOR
Richard A. Oman Jan. 1964 9 p
(RN-174L)

Design criteria, selection of internal environment simulator (IES), and the pressure-time performance for the system are discussed. The pressure at the exit of the cabin dump valve at any given time is given and the conditions for simulation are specified. It is concluded that the IES should consist of a dump chamber connected as directly as possible to the cabin dump valve and backed by a large vacuum pump. The volume flow rate of the pump through its inlet pipe must be very large and the blank-off pressure must be below 1 mm Hg. The criterion for satisfactory performance is specified. Although it appears to degrade performance slightly, a dump chamber is actually advisable. It helps break up the surge which will occur at the valve opening. If there were no dump chamber, this surge would reflect from the pump inlet, or the first bend or constriction in the pipe, and might break up the nozzle flow. E.E.B.

N65-21277*# Minnesota Univ., Minneapolis. Heat Transfer Lab.
AN ARC TUNNEL FACILITY FOR THE THERMAL ANALYSIS OF ANODE AND CATHODE REGIMES IN AN ELECTRIC ARC COLUMN Summary Report, Jul. 1963–Jun. 1964
E. Pfender, S. A. Wutzke, and E. R. G. Eckert Aug. 1964 87 p refs
(Contract NAS3-2595)
(NASA-CR-54080; HTL-TR-58) CFSTI: HC $3.00/MF $0.75

An arc-tunnel test facility which permits a wide variety of parameter settings was designed and constructed. The flow uniformity in the test section was established. Experiments in an argon atmosphere disclosed two different modes of an arc with axial flow—fluctuating steady. An attempt was made to explain the symptomatic behavior of the fluctuating mode. Arc characteristics for several parameter settings were determined. High speed motion pictures were used to quantitatively study both the arc characteristics and the arc's symptomatic behavior. A large number of overall energy balances were established to study the influence of different parameters. Some preliminary experiments in hydrogen using a cylindrical, heated tungsten anode are reported. Author

N65-21299*# National Aeronautics and Space Administration, Washington, D. C.
NEWS CONFERENCE: MANNED SPACECRAFT CENTER MISSION CONTROL ANNOUNCEMENT News Release
George E. Mueller and Alfred P. Alibrando 9 Apr. 1965 22 p Available from the Scientific and Technical Information Division

Dr. George E. Mueller, National Aeronautics and Space Administration, discusses the shift of mission control from Cape Kennedy to the Mission Control Center at Houston and describes the available facilities. Some of the 11 experiments to be carried by the Gemini/Titan-4 mission are briefly outlined, and an overall view of the trajectory and mission profile of the GT-4 are discussed. G.G.

N65-21315*# Naval Propellant Plant, Indian Head, Md.
PNEUMATIC MIX PROCESS Technical Summary Report [1964] 12 p
(NASA-CR-57970) CFSTI: HC $1.00/MF $0.50

An installation for continuously manufacturing composite propellant, by means of the Pneumatic Mix Process, was constructed. Three runs, where 15KS 1000 JATO propellant was continuously mixed, cast, and deaerated were accomplished with no processing difficulty or equipment malfunction. Evaluation of the cured propellant indicated the product was homogeneous, dense, and possessed mechanical and ballistic properties comparable to conventionally processed material. Plant modifications to allow processing of HB series composite propellants were completed. Preliminary ballistic, physical, and rheological properties of batch-mixed HB series composite propellant were determined. Author

N65-21367# Kitt Peak National Observatory, Tucson, Ariz.
[TELESCOPES, OPTICAL INSTRUMENTATION AND FACILITIES FOR ASTRONOMICAL AND ASTROPHYSICAL RESEARCH] Monthly Report, Sep. 1964
N. U. Mayall [1964] 27 p refs Sponsored by NSF Prepared jointly with Cerro Tololo Inter-Am. Obs., La Serena, Chile

Results of shop tests on large fused quartz mirror blanks were discussed with the manufacturer's representative. The initial architectural study for the new building addition to Tucson headquarters was authorized. Weather information for Kitt Peak is reported. The 84-inch telescope became officially available for use by visiting astronomers. Scheduled time for the 84-inch, 36-inch, and 16-inch telescopes is detailed. Measuring of transition probabilities and other fundamental constants of molecules and atoms is proceeding. Leveling of the site for the Cerro Tololo Inter-American observatory was completed, and a resume of temperature, humidity, wind, and precipitation data at Cerro Tololo for August is given. A recording anemometer and a thermohygrograph are operating at the Cerro Pachon site, and seeing studies are being carried out. Programs underway include setting up of spectrophotometric standards, spectral intensity distribution of representative stars of all types, monochromatic light curves for selected variable stars, and search for luminosity, spectral type, and age criteria in spectra of late-type stars. L.S.

N65-21427# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
EXPERIMENTAL STUDIES IN A LOW DENSITY GUN TUNNEL STREAM
Hakuro Oguchi, Hiroki Honma, and Katsushi Funabiki Jan. 1965 19 p refs
(ISAS-394, Vol. 30, No. 3)

A flow survey for the low-density hypersonic flow is achieved by a low-density operation of the gun tunnel (or free piston compression). The measurements of flow velocity and of stagnation temperature are worked out by means of an explosion-wire technique, and the flow survey is done by traversing a free molecule calorimeter in the test flow region. The characteristic feature of the test flow is investigated; and it is found that, by a low-density operation of the present gun tunnel, the test flow of Mach 10 and Reynolds number 650 per cm is achieved. An experimental study is made concerning the shock-layer structure ahead of a sphere in a low-density hypersonic flow. The scanning-electron-beam densitometer is developed to obtain a density distribution along a scanning path of the beam during one shot of the gun tunnel. By means of this device the density distribution across the shock layer is measured for a sphere of 12.4 mm in radius, in which case the Reynolds Re_∞ is about 800. The present data exhibit a qualitative agreement with Levinsky–Yoshihara profile which was computed for argon flow of Mach $M = 10$ and $Re_\infty = 10^3$ and 10^2. Author

N65-21439# Eurospace, Paris (France). Technical Study Group
LABORATORY TEST METHODS AND FACILITIES Memorandum No. 1
Jun. 1964 21 p

Special test methods for space activities and their respective cost over a 5-year period are presented. The following three major projects correspond to the main selected items that comprise the European Space Program: (1) satellites of a mass up to 1 to 2 tons representing the probable requirements of the projected missions; (2) aerospace transporter; and (3) nuclear stage. The first project is considered essential for accomplishing the future plan and the new required test facilities should be defined under consideration of already-established test installations. G.G.

N65-21444# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
THE PERFORMANCE OF A SHOCK TUBE MODIFIED FOR USE IN RAMJET INLET INVESTIGATIONS
Terence Joseph O'Rourke (M.S. Thesis) Aug. 1964 70 p refs
(GA/ME/64-4; AD-610175)

A study was conducted to test the feasibility of using the shock tube for ramjet inlet investigations. A reduced-width test

section containing Mach 4 convergent–divergent nozzle blocks was attached to the shock tube. Mach number and flow steadiness measurements were made in the test section. A ramjet inlet model was installed, and flow-field schlieren pictures were recorded using still and high-speed motion picture photography. Comparison of theoretical flow patterns with the flow patterns over the inlet model showed close agreement except for distortion due to the boundary layer on the walls of the tube. The reduced width of the test section improved the quality of the schlieren pictures and the test flow times obtained in previous studies. Steady flows of average Mach 3.05 were obtained for 20 milliseconds. Test flow time was found to be a function of shock strength, while the test-section Mach number and flow steadiness appeared to be independent of shock strength. Selected flow-field pictures are included.

Author

N65-21468*# Chrysler Corp., Huntsville, Ala. Space Div.
SA-9 VEHICLE AND LAUNCH COMPLEX FUNCTIONAL DESCRIPTION. VOLUME III: LIQUID HYDROGEN SYSTEM
May 1964 61 p
(Contract NAS8-4016)
(NASA-CR-6217; HEC-D042, Vol. III) CFSTI: HC $3.00/MF $0.50

The liquid hydrogen fuel system that supplies the S-IV (second stage) propulsion system is described. The storage facility and its operation, the fill operations, flight requirements, liquid hydrogen drain, secure operations, and the liquid hydrogen system interlocks are discussed. A mechanical schematic drawing of the liquid hydrogen system is attached. G.G.

N65-21469*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME LANGLEY RESEARCH CENTER PLANS IN THE AREA OF VISUAL DISPLAYS FOR LUNAR MISSION SIMULATION
Donald R. Riley and Byron M. Jaquet [1964] 22 p refs Presented at the 1964 Ann. Meeting of the Armed Forces-NRC Comm. on Vision, Washington, 23–24 Apr. 1964
(NASA-TM-X-51758) CFSTI: HC $1.00/MF $0.50

Simple guidance techniques for pilot control of various tasks associated with the lunar mission were studied through analytical and simulation procedures. These simplified techniques and pilot utilization should increase the reliability of Project Apollo and other manned space missions. Results of simulator studies have shown that, given proper information, pilots can perform rendezvous and docking. Also, the usefulness of simulator devices was demonstrated in Project Mercury. Simulation devices will provide information necessary for the lunar and other space programs. The lunar orbit and landing approach simulator and the lunar landing research facility are discussed. E.E.B.

N65-21488# National Aeronautical Lab., Bangalore (India).
CALIBRATION OF THE 5 IN. × 5 IN. INDUCTION TUNNEL WITH 2 IN. × 10 IN. TEST SECTION HAVING NORMAL HOLE PERFORATED WALLS AND WITHOUT PLENUM AUXILIARY SUCTION
N. L. Arora Sep. 1964 26 p refs
(TN-AE-25-64)

The NAL 5- × 5-in. induction-type transonic tunnel with a two-dimensional test section of 2 × 10 in. has been calibrated with top and bottom nozzle plates having normal perforated holes. The results are presented in the form of the basic tunnel calibration, the Mach number distribution along the perforated wall, the energy ratio, and the characteristics of the flow across the test section. During the tests, the blowing pressure was varied from 30 to 60 psig, while the injector nozzles were completely open and the divergence angle of the test section top and bottom plates was kept fixed at 2°. The results were used to determine the useful working region where the test model can be located. It is also found that 40% width of the test section on either side of the center line is not affected by the sidewall boundary layer. Author

N65-21663*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CRYOSORPTION—A METHOD FOR SIMULATING THE SPACE VACUUM ENVIRONMENT
James E. A. John and William F. Hardgrove 26 Jan. 1965 26 p refs
(NASA-TM-X-55195; X-322-65-45) CFSTI: HC $2.00/MF $0.50

A cryosorption chamber system for simulating outer space vacuums down to 10^{-16} torr is being constructed for testing flight units. This low pressure will permit investigation of surface effects such as cold welding, friction, sublimation, and outgassing. The proposed system, which is said to be economically feasible, consists of three concentric chambers, the outermost being 3 feet in height and diameter, the innermost containing a test volume 20 in. by 20 in. Liquid nitrogen is the proposed coolant. Instruments for measurement of pressure or molecular flux at several points in the test chamber, and for determining the predominant molecular species and their partial pressures, are discussed. Two simulator designs, and vacuum ranges of applicability of various gages and pumping methods, are shown. Data are presented on the effect that nitrogen frozen on surface has on pumping speed, and the equilibrium adsorption of hydrogen on a molecular sieve at 20° K. J.M.D.

N65-21673# Sperry Gyroscope Co., Great Neck, N. Y. Radiation Div.
DESIGN CRITERIA STUDY FOR HIGH POWER HIGH VOLTAGE RESEARCH FACILITY Final Engineering Report, 1 Jul. 1963–30 Sep. 1964
Oct. 1964 74 p
(Contract DA-36-039-AMC-03199(E))
(EB-5288-0536; AD-458408)

A survey was made of the anticipated requirements for high-voltage, high-power, and high-energy research facilities during the 1970 decade. The areas surveyed include high-power radar and communication components, lasers, plasmas, etc. A preliminary design of a facility to meet these needs was made. The facility includes a 500-kV 10-A dc power supply, a 6.25×10^6- joule energy storage bank, a 1000-kV dc high potential tester, modulators, rf drivers, microwave resonant rings, etc. An economic analysis of the initial facility cost and the annual operating costs has been made, and a complete schedule for the facility construction is presented. Author

N65-21710# California Univ., Livermore. Lawrence Radiation Lab.
MECHANICAL DESIGN FOR PLASMA PHYSICS RESEARCH
W. S. Neef, Jr. 14 Jan. 1965 35 p refs
(Contract W-7405-ENG-48)
(UCRL-12325) CFSTI: $2.00

The major mechanical engineering requirements for plasma physics experiments are reviewed. The Alice machine, a neutral injection experiment, is reviewed as a mechanical design study.

Topics emphasized are (1) magnet design and fabrication; (2) beam source design, both analysis and experiment; (3) vacuum pumps, valves, and seals for ultrahigh vacuum conditions; (4) mechanical problems encountered with diagnostic tools; and (5) materials and fabrication techniques. A survey of new techniques in cryopumping is followed by a discussion of the "minimum B" magnetic fields, including both Ioffe bars and "baseball seam" conductor shapes. Author

N65-21717# Suffield Experimental Station, Ralston (Alberta).
PREPARATIVE ELECTROPHORESIS EQUIPMENT FOR LABORATORY USE
R. K. Shaw 28 Apr. 1964 20 p
(Suffield-TP-204)

Three different preparative electrophoresis units are described. The design and construction of these improved units are described in detail to facilitate the fabrication of similar equipment. Author

N65-21743# MHD Research, Inc., Newport Beach, Calif.
ENVIRONMENTAL EMP SIMULATOR: PORTABLE AND FIXED INSTALLATIONS
12 Mar. 1964 7 p refs

The basic design for a nuclear electromagnetic pulse simulator, to study the adverse effects on military electronic and electrical systems caused by the high-intensity electromagnetic fields in the vicinity of a nuclear detonation, is presented. This simulator will produce damped low-frequency sinusoidal electric and magnetic fields in a volume of several cubic meters, and can be extended through modifications of the basic design. Illustrations of fixed and portable installations for the simulator are attached. G.G.

N65-21771*# SPACO, Inc., Huntsville, Ala. Engineering Div.
MULTI-DEGREE OF FREEDOM OSCILLATOR FOR GEORGE C. MARSHALL SPACE FLIGHT CENTER Final Report
John Melonas 11 Mar. 1965 15 p
(Contract NAS8-11565)
(NASA-CR-62221) CFSTI: HC $1.00/MF $0.50

A multidegree of freedom oscillator capable of inducing controlled sinusoidal motions for scale-model tests of slosh patterns in Saturn LOX tanks was made; final design activities are reported. Increase in size and weight of the test vessel supports introduced problems in the mechanical drive systems of the pitch and yaw, and in the hydraulic piston drive of the vertical motion; these problems, including electrical failures and extraneous mechanical motions, were overcome. Test data indicate essentially sinusoidal motions for all modes and generally good overall oscillator operation. The limiting factor is the drive system; approximately 2 G's is the maximum recommended limit for lasting performance. Photographs show the final system. The amplitude and frequency specifications for the directions of motion are given. J.M.D.

N65-21780*# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
SLRV CONTROL STUDY Final Report
Mar. 1965 155 p Prepared for JPL
(Contracts NAS7-100; JPL-951056)
(NASA-CR-62261; TR65-20) CFSTI: HC $5.00/MF $1.00

Design studies, perception tests, and vehicle tests of the evaluation program for the earth-based control of the Surveyor Lunar Roving Vehicle are reported. Step-motion, step-steering, camera location, camera height, field of view, stereo baseline, detectability, path planner, vehicle controller, and mobility checkout are discussed. Also, the equipment used to produce and display stereo photographs of predefined objects, using a closed circuit TV system, photographic camera, and conventional stereo projector is described. A test matrix of 96 stereo slides was produced. Each slide portrayed a crevice and a slope permitting data reduction for depth perception of a line at two distances and measurement of a slope from each slide. Further, the objectives, organization, equipment, operators, and program constraints for the vehicle test program are explained, and the test data are presented. E.E.B.

N65-21781# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOVIET EVAPOROGRAPHIC CHAMBER TO REPRESENT REMOTELY THE INFRARED ZONE OF THE SPECTRUM
3 Feb. 1965 6 p ref Transl. into ENGLISH from Jemna Mech. A Opt. (Czech.), no. 10, 1963 p 325
(FTD-TT-64-914/1; AD-457869)

An evaporographic chamber for infrared photography is described that can be operated under condensation as well as evaporation. The chamber is divided by a thin diaphragm, one side of which is covered by a thin layer of a substance which absorbs infrared radiation in the 1 to 10 μm zone. The radiation passes through a small front window, is reflected by the glass layer of the rear wall of the chamber through the absorbent screen and transmitted through the window on a membrane. The vacating and heating of the injected liquid in the rear chamber is controlled so that it condenses on the membrane into a uniformly thin layer. A light source obliterates the image which originated on the membrane. For the condensation method the light is disconnected. The condensation method functions at object temperatures of less than 70° C, while the evaporation method is more convenient for higher temperatures. The image of an object with a temperature several degrees higher than room temperature can be prepared within several seconds using this method. G.G.

N65-21790# European Organization for Nuclear Research, Geneva (Switzerland). Accelerator Research Div.
SOME RESULTS OF STACKING EXPERIMENTS WITH THE CERN ELECTRON STORAGE AND ACCUMULATION RING (CESAR)
S. Hanson, E. Jones, H. Koziol, and M. J. Pentz 25 Feb. 1965 21 p refs
(CERN-65-8)

Radiofrequency stacking was studied experimentally. In testing stacking with full buckets, a scanning bucket was produced by a radiofrequency system to measure energy distribution of electrons in the stack and to detect the occurrence of spillout. The stacking process was repeated to produce an n-pulse stack with n = 25. Stacking efficiency was defined in terms of particle densities in the stack and at ejection; from results of this experiment it was inferred that an overall stacking efficiency of at least 50% can be achieved in design of the intersecting storage rings for the CERN proton synchroton. Testing was also done on stacking with partly empty buckets; for particular parameter values in the iterative bucket area equation, stacking efficiency was greater than 100% and increased with increasing degree of bucket emptiness. This surprising result led to a third experiment, on the effect of moving entirely empty buckets through a stacked beam. Accuracy in these experiments was limited to ±10% to 20%. J.M.D.

N65-21792# Stanford Univ., Calif. Stanford Linear Accelerator Center

FUNCTIONAL DESCRIPTION OF THE TRIGGER SYSTEM FOR THE STANFORD TWO-MILE ACCELERATOR

J. Faust Jan. 1965 23 p
(Contract AT(04-3)-400)
(SLAC-35) CFSTI: $0.50

Described is the trigger system for precise timing of the switching of the various subsystems that produce the pulsed electron beam for the linear accelerator. The system consists of a sequence generator, a rate selector, a master trigger generator, a sector trigger generator, and a pattern generator. A maximum of 360 pulses are generated by this system in any second allowing for a variety of patterns to be programed into the three pattern generators, and the different energy requirements are satisfied by using the switch matrix to select the proper number of sectors for each beam. The pattern pulses arrive at the sectors sufficiently in advance of the beam to switch the sector from a standby pulse to a prompt pulse. The pulses sent to all eight modulators are timed to accelerate the beam. G.G.

N65-21793# Stanford Univ., Calif. Stanford Linear Accelerator Center

HIGH REPETITION RATE PULSER FOR BEAM SWITCHING MAGNET

J. L. Cole and J. J. Muray Feb. 1965 53 p refs
(Contract AT(04-3)-400)
(SLAC-36) CFSTI: $1.25

The electron beam from the 2-mile linear accelerator is analyzed by a high-quality magnetic deflection system in the beam switchyard. The first magnet element in this system is a pulsed switching magnet capable of switching beams of different energies and intensities to either transport system on a pulse-to-pulse basis. This magnet actually consists of five 1-meter sections and is powered by pulsed high-voltage supplies (modulators). Each magnet section is excited with two modulators because it must pulse in either polarity in order to switch the beam left or right; the pulse height should be continuously variable to accommodate any beam energy. The magnetic field in these magnets rises sinusoidally 360 times a second and has a peak value of 1700 G. The optical properties of the pulsed magnet are discussed briefly. Detailed descriptions of the pulsed magnet modulators, the instrumentation for the magnet, and the test results are given. The problems connected with high-power switching at high repetition rates are also discussed. Author

N65-21809# California Univ., Berkeley. Lawrence Radiation Lab.

BEVATRON OPERATION AND DEVELOPMENT. 43 Quarterly Report, Jul.–Sep. 1964

Robert W. Allison, Jr., Kenneth C. Crebbin, William L. Everette, and Emery Zajec 12 Feb. 1965 19 p ref
(Contract W-7405-ENG-48)
(UCRL-11935) CFSTI: $1.00

The Bevatron beam was on for 87.1% of the scheduled operating time. A loss in efficiency of injected-beam pickup was caused by a shorted turn in one of the inflector magnets. Injector studies showed a misalinement of the injector beam-transport system; the injector was realined during the shutdown. The external proton beam channel was extended to the third focus. Author

N65-21842# Stanford Univ., Calif. Stanford Linear Accelerator Center

TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Jul.–30 Sep. 1964

Jan. 1965 119 p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-34) CFSTI: $2.50

Progress in constructing the 2-mile linear electron accelerator is reported for the accelerator itself and the related technical equipment, and for the more conventional activities associated with site preparation, buildings, utilities, etc. Work is reported in plant engineering, systems engineering and installations, accelerator physics, instrumentation, heavy electronics, mechanical design and fabrication, klystron studies, Mark IV program, beam switchyard, target area development, and preoperational research and development. M.P.G.

N65-21874# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

DIAGNOSTIC EXPERIMENTS IN A MAGNETICALLY DRIVEN SHOCK TUBE

John B. Heywood Jan. 1965 62 p refs
(Contracts DA-36-039-AMC-03200(E); Nonr-1841(93); Grant NSF GK-19)
(Publ.-65-1; AD-610583)

The results obtained from a series of experiments in hydrogen in a magnetic annular shock tube with an applied axial magnetic field are described. Measurements of the front speed were made over as wide a range of initial gas pressure, initial drive band voltage, and axial magnetic field as possible. These results are compared with the predicted speeds obtained from the Kemp and Petschek solutions and the snowplow model; reasonable agreement is obtained. Measurements were also made on the front properties with magnetic and electric field probes inside the annulus, and with phototubes. It was found that a substantial fraction of the drive current always flows in the front, and no shock wave preceding the current sheet was observed. A detailed picture of the current distribution inside the annulus is obtained, and a current loop was found to flow behind the front. It is shown that electric field measurements substantiate this picture. It is also shown that when the Alfvén speed ahead of the front is comparable with the front speed, the flow pattern changes significantly. Author

N65-21884# Bettis Atomic Power Lab., Pittsburgh, Pa.

TEST RIG FOR USE IN WEAR AND FRICTION STUDIES IN A WATER ENVIRONMENT

N. B. Dewees Mar. 1965 40 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-288) CFSTI: $2.00

A test rig is described for measuring the rate of wear and the coefficient of friction for materials tested in a pressurized water environment at temperatures to 500° F. The rig operates with either a continuous sliding or an oscillating motion. Two different designs of specimens are tested simultaneously to show in a single test whether loading or design of specimens may significantly affect test results. Tests can be performed with a unit loading on the wear surfaces of 30 to 9000 psi with the standard specimens. Evaluation of a material combination is based upon relative wear rates between the two types of specimens as well as the magnitude and trend of wear rate and roughness in successive test intervals. Examples are given for material combinations having widely different performance. Author

N65-21900# ARO, Inc., Arnold Air Force Station, Tenn.

FIFTH ANNUAL SYMPOSIUM ON SPACE ENVIRONMENT SIMULATION

Donald W. Male [1964] 313 p refs Symp. held at Arnold Eng. Develop. Center, 21–22 May 1964
(AD-441312)

CONTENTS:

1. THERMAL RADIATIVE PROBLEMS OF SPACECRAFT SIMULATION R. E. Gaumer (Lockheed Missiles and Space Co.) 11 p (See N65-21901 11-11)

2. SOME THERMODYNAMIC PRINCIPLES OF RADIATIVE TRANSFER IN OPTICAL SYSTEMS H. Fischel (Honeywell, Inc.) 49 p (See N65-21902 11-11)

3. REVIEW OF RADIATION SOURCES FOR SOLAR SIMULATION G. Mac Farlane (Arnold Eng. Dev. Center) 70 p refs (See N65-21903 11-11)

4. THE 20 FOOT SOLAR SIMULATOR AT THE GODDARD SPACE FLIGHT CENTER J. C. New (NASA. Goddard Space Flight Center) 18 p refs (See N65-21904 11-11)

5. CORRELATION OF ANALYTICAL AND SPACE CHAMBER THERMAL BALANCE DATA WITH FLIGHT DATA (TIROS AND RELAY) E. A. Goldberg (RCA) 22 p refs (See N65-21905 11-11)

6. GEMINI DEVELOPMENT BY COMBINED SYSTEM TESTS A. M. Paolini (McDonnell Aircraft Corp.) 27 p refs (See N65-21906 11-11)

7. MANRATING FEATURES OF THE SPACE ENVIRONMENT SIMULATION CHAMBERS AT NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MANNED SPACECRAFT CENTER, HOUSTON, TEXAS D. Furlong, D. J. Goerz, Jr., and F. R. Mayer (Bechtel Corp.) 41 p (See N65-21907 11-11)

8. VACUUM LEAK DETECTION OF LARGE SPACE ENVIRONMENTAL CHAMBERS S. P. Ansley, Jr. 30 p refs (See N65-21908 11-11)

9. PROBABILITY AND MOLECULAR FLOW IN VACUUM SYSTEMS D. J. Santeler (Aero Vac Corp.) 21 p refs (See N65-21909 11-11)

N65-21901 Lockheed Missiles and Space Co., Sunnyvale, Calif.

THERMAL RADIATIVE PROBLEMS OF SPACECRAFT SIMULATION

R. E. Gaumer *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 11 p (See N65-21900 11-11)

The determination of thermal radiative behavior in spacecraft simulation chambers depends upon an understanding of the fundamental physical processes associated with the physical transfer of thermal energy in a composite space vehicle. Various test parameters include chamber pressure; temperature measurement; albedo and earthshine simulation; insulation simulation; internally generated thermal load; thermal similitude; material solar absorptance; material infrared emittance; contamination and oxidation effects; and data reduction, analysis, collation, and distribution. It was concluded that thermal space chamber simulation tests with the objective of verifying analytical predictions are illogical. Specific experiments of thermal energy transfer in a bell jar-type vacuum will provide the information from which the overall heat transfer scheme can be synthesized. Full-scale chamber tests should be employed for terrestrial laboratory evaluations of spacecraft or satellite systems performance. G.G.

N65-21902 Honeywell, Inc., West Covina, Calif. California Ordnance Center

SOME THERMODYNAMIC PRINCIPLES OF RADIATIVE TRANSFER IN OPTICAL SYSTEMS

Halbert Fischel *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 49 p (See N65-21900 11-11)

The theoretical aspects of physics which bear upon the problem of simulating solar radiation in the laboratory are discussed. The concepts of brightness, radiance, flux density, reduced field, and average brightness are defined. The most fundamental of these was shown to be the system e.f.l. and the solar field angle. Also, uniformity criteria were derived from the laws governing radiance parameters, and it was indicated how these could provide design analysis and synthesis information. Further, the framework defined for energy tracing through an optical system can ultimately be used to check the distributions obtained by any given design. Finally, it was concluded that the problem is far from completely solved on either a theoretical or practical level. E.E.B.

N65-21903 Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

REVIEW OF RADIATION SOURCES FOR SOLAR SIMULATION

George Mac Farlane *In* ARO Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 70 p refs (See N65-21900 11-11)

This paper summarizes the philosophy underlying the radiation source development program initiated in 1962. The techniques employed to obtain the required radiometric data are outlined, and capsule reports are presented on the radiometric characteristics of three high-powered radiation sources. The present state of development of the various available sources is discussed, and suggestions are made regarding the direction of future research in this field. Author

N65-21904 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE 20 FOOT SOLAR SIMULATOR AT THE GODDARD SPACE FLIGHT CENTER

John C. New *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 18 p refs (See N65-21900 11-11)

A brief progress report on the installation of the 20 ft solar simulator at the Goddard Space Flight Center is given. Author

N65-21905 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

CORRELATION OF ANALYTICAL AND SPACE CHAMBER THERMAL BALANCE DATA WITH FLIGHT DATA (TIROS AND RELAY)

E. A. Goldberg *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 22 p refs (See N65-21900 11-11)

(C-2126)

The Tiros spacecraft program demonstrated that, for a simple spinning spacecraft in a given orbit, it was feasible to predict analytically the orbital thermal conditions with reasonably small error. Thermal-vacuum testing of the Tiros spacecraft was limited to thermal soak testing. This proved adequate for detecting weak components and component hot spots, but did not provide thermal balance data. The thermal gradient tests used on the Relay program appeared to be more reliable for predicting orbital spacecraft temperatures than were the tests employing a simple solar simulator and were less expensive. Results of both type tests were adequate. The more expensive solar simulation approach needs to be further refined to achieve better correlation. The probable added expense makes the isothermal shroud technique look even more attractive. All results demonstrated the soundness of using rather simple means, tailored for each particular spacecraft, to predict thermal balance. E.E.B.

N65-21906 McDonnell Aircraft Corp., St. Louis, Mo.

GEMINI DEVELOPMENT BY COMBINED SYSTEM TESTS

A. M. Paolini *In* ARO Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 27 p refs (See N65-21900 11-11)

Gemini system performance is evaluated through combined system tests. Systems are combined and tested under vacuum–thermal conditions to determine thermal equilibrium characteristics. Ten new vacuum–thermal chambers installed are cylindrical in shape having diameters ranging from 2 1/2 feet to 30 feet. Each chamber size is equipped with a cold wall maintained at liquid nitrogen temperature, and a vacuum pumping system consisting of oil diffusion pumps backed by mechanical pumps capable of attaining pressures in the 10^{-8} torr range. The various sized chambers were selected to test Gemini components, systems, and complete vehicles. A major combined system test of a complete Gemini production vehicle is being prepared in the 30-foot diameter chamber. Author

N65-21907 Bechtel Corp., San Francisco, Calif.
MANRATING FEATURES OF THE SPACE ENVIRONMENT SIMULATION CHAMBERS AT NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MANNED SPACECRAFT CENTER, HOUSTON, TEXAS
Donald Furlong, David J. Goerz, Jr., and Franklin R. Mayer *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 41 p (See N65-21900 11-11)
(Contract DA-41-443-ENG(NASA)-12)
(SDD-92-5)

The space environment simulation chambers comprise two large, man-rated chambers for the training of astronauts and for the testing of spacecraft in an environment simulating some of the parameters of outer space. Man-rating of the chambers involves the manlocks, access arrangements, and emergency repressurization system. Also, for the life support of test subject personnel, environmental control systems are included as well as monitoring systems and surveillance means to collect physiological data and insure safety. Hazards to which suited chamber subjects are exposed and physiological results are presented. An important safeguard for chamber personnel is the emergency repressurization system which is described in detail. Further, the external environmental control systems, biomonitoring, and surveillance systems are outlined. E.E.B.

N65-21908 ARO, Inc., Arnold Air Force Station, Tenn. Aerospace Environmental Facility
VACUUM LEAK DETECTION OF LARGE SPACE ENVIRONMENTAL CHAMBERS
S. P. Ansley, Jr. *In its* 5th Ann. Symp. on Space Environment Simulation [1964] 30 p refs (See N65-21900 11-11)
(Contract AF 40(600)-1000)

The available leak detection methods, techniques, and equipment are discussed, and the need for establishing them as a normal part of space facility operations rather than stopgap measures is illustrated. It was concluded that a well-organized and well-equipped leak detection effort can make a substantial contribution to the overall operational efficiency of a major space simulation system. The equipment recommended included the following: (1) an on-line mass spectrometer; (2) standard mass spectrometer helium leak detectors capable of extended use in the field with a sensitivity of about 10^{-10} atm cc/sec; (3) equipment for quantitative determination of helium under the hood or bag; (4) a special mass spectrometer leak detector using neon or argon for those systems having high helium background; and (5) standard leak detection equipment such as halogen and acoustic detectors to identify large leaks prior to using the mass spectrometers. E.E.B.

N65-21909 Aero Vac Corp., Troy, N. Y.
PROBABILITY AND MOLECULAR FLOW IN VACUUM SYSTEMS
Donald J. Santeler 19 May 1964 *In* ARO, Inc. 5th Ann. Symp. on Space Environment Simulation [1964] 21 p refs (See N65-21900 11-11)

Additional new techniques are introduced, and how these new techniques and presently developed probability approaches may be used to solve problems ranging from simple gas flow through tubes to complex trap or space simulator arrangements is illustrated. The flow of gas through cylindrical tubes is considered as an introduction to the application of probability. The more complex problem of traps and baffles is then discussed. Finally, it was noted that the diffuse reflection of electromagnetic radiation behaves in a fashion similar to the reflection of molecules. Hence, the analysis of heat loads reflected to cryogenic panels may be solved by the methods of probability. Similarly, honeycomb panels may be solved for their ability to trap molecules or radiation. Further, it is observed that probability is not a replacement for other techniques. E.E.B.

N65-22002# Hercules Powder Co., Cumberland, Md. Testing Dept.
ALLEGANY BALLISTICS LABORATORY TESTING DEPARTMENT FACILITIES
Mar. 1965 48 p
(ABL/X-136; AD-460909)

Testing facilities, functions, and major capabilities of the Allegany Ballistics Laboratory are described. Static test, structural test, data computing, instrumentation and nondestructive facilities are outlined, and a description of the standards laboratory, analytical laboratories, general method and philosophy of data acquisition, and departmental organizations is given. L.S.

N65-22005# Dresser-Ideco Co., Columbus, Ohio.
TOWER FOR MULTIPLATE ANTENNA Engineering Report No. 1, May 1963–Oct. 1964
Jonn K. Groseclose Oct. 1964 110 p refs
(Contract AF 19(628)-2977)
(AFCRL-65-4; AD-460772)

This report describes the investigations and procedures associated with the design of a 1000-foot tower to support the feed system of a multiplate antenna. The feed system rests on a steerable platform which corrects for lateral displacement of the tower. The tower design procedure incorporates consideration for the structural limitation of the deflection within the practical limits possible in a free environment. Author

N65-22036# Thiokol Chemical Corp., Brigham City, Utah.
WING VI STAGE I MINUTEMAN RESEARCH AND DEVELOPMENT. WEAPON SYSTEM 133 B Status Report, 1 Jul.–30 Sep. 1964
U. E. Garrison [1964] 10 p
(Contract AF 04(694)-271)
(AD-461461)

The standardized igniter safety and arming device for Minuteman Wing VI was redesigned to reduce the possibility of inadvertent launch and to eliminate the failure modes involving internal shorting of the electrical circuits; fusing wire, wire isolation, advantages of lost motion switch, and blade and clip material change, in the redesigned model are described briefly. In the Minuteman value engineering program, status and estimated savings in dollars are reported for numerous

projects. Administrative efforts are outlined for the logistic support, special requirements, flight test, weapon system safety, and nuclear hardness projects. J.M.D.

N65-22060# National Aeronautical Lab., Bangalore (India).
UTILISATION OF WIND POWER IN ARID AND SEMI-ARID AREAS IN INDIA
S. P. Venkiteshwaran and K. R. Sivaraman Nov. 1964 23 p refs
(TN-WP-35-64)

The WP-2 type of water pumping windmill is useful in regions of low and moderate wind speeds. The average wind speed at most of the places in Rajasthan during the summer months, which are the windiest, varies from 12 to 18 km per hour and the windmill gives its optimum output in this range of wind speeds. The wind speed data available for five stations in Rajasthan have been analyzed, and the monthly quantities of water that can be pumped by a WP-2 windmill through a height of 10 meters have been worked out for these stations. It is seen that the WP-2 windmill can pump about 15000 gal of water per day through a height of 10 meters under favorable wind speeds during summer months. The economics of operation of WP-2 windmills at these places has also been studied. At all places studied the water pumped is a maximum during the summer months. A study of the characteristics of wind electric generators of different capacities ranging from 1kW to 25kW in relation to the wind regime in Rajasthan shows that wind electric generators in the range of 2 to 5 kW are comparatively economical. Author

N65-22086# Midwestern Universities Research Association, Madison, Wis.
THE NUMERICAL DESIGN OF A RESONANT EXTRACTION SYSTEM FOR THE MURA 50-MEV ELECTRON ACCELERATOR
Philip F. Meads, Jr. 1 Mar. 1965 27 p refs Prepared under Subcontract for ANL Sponsored by AEC
(MURA-712) CFSTI: $2.00

Detailed numerical investigations of a proposed half-integral resonant-extraction system for fixed-field, alternating-gradient synchrotrons verify the feasibility of extracting a high-quality beam from the MURA 50-MeV FFAG by this method. The half-integral resonance causes a large growth in the radial betatron amplitude, enabling the extraction of virtually the entire beam with an exceedingly small emittance. The method is complicated by the inclusion of time-varying parameters, required to maintain a relatively constant emittance and apparent source in the extracted beam over the extraction interval. Calculations were performed on an IBM 704 digital computer using measured magnetic fields. Author

N65-22100# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
DESCRIPTION AND POTENTIAL OF THE ONERA AERO-THERMODYNAMIC TEST-CENTER OF MODANE, FRANCE [CONSTITUTION ET POSSIBILITES DU CENTRE D'ESSAIS AEROTHERMODYNAMIQUES DE MODANE-AURIEUX]
Marcel Pierre 1964 48 p refs In FRENCH; ENGLISH summary
(ONERA-TN-77)

The Aerothermodynamic Test Center of Modane comprises three wind tunnels and a vacuum tank. Another wind tunnel for hypersonic speed is being built. The maximum power of 88000 kW is given directly by the hydraulic energy from the Aussois dam. Many tests have been carried out since 1952 when the first wind tunnel became operational. The flexibility of the organization and the variety of the facilities provide this center with large possibilities for solving the various problems of the European aerospace designers and manufacturers. Author

N65-22127*# Boeing Co., Seattle, Wash. Aero-Space Div.
ELECTRO-OPTICAL SIMULATION OF SATURN SPACECRAFT MANEUVERS Final Report, Jun. 1964–Jan. 1965
Mar. 1965 28 p refs
(Contract NAS8-11399)
(NASA-CR-62351; D2-23910-1) CFSTI: HC $2.00/MF $0.50

This report summarizes the preliminary study detailed design, and gives a complete description of the resulting simulator cockpit for electro-optical simulation of Saturn spacecraft maneuvers. An initial study was made of the engineering requirements for a simulator cockpit for use in visual simulation of astronautical flight research. An evaluation of the potentialities of the various concepts resulted in a final design consisting of a single base unit with interchangeable cab configurations. This report provides a description of the final simulator cockpit for familiarization and reference drawings which provide critical dimensions for use in planning and installation of instruments. Author

N65-22138# White Sands Missile Range, N. Mex. Inter-Range Missile Ground Safety Group
INTER-RANGE PROGRAM FOR CONTROL OF TOXIC MATERIAL
Feb. 1965 6 p
(IRMGSG-210-64; AD-441144)

A toxicity control program designed for the protection of onbase personnel and the general public, and intended to minimize onrange interference in areas of evacuation and facility contamination is described. Proposed is a program encompassing meteorology, hydrology, oceanography, and geology to provide information in respect to diffusion characteristics of the atmospheric and terrestrial environment. Also proposed are studies of the emission rates of toxic material and short term exposure limits of industrial toxic material. The general responsibilities of range users and the Range Commander are discussed. S.C.W.

N65-22188*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LANGLEY RESEARCH CENTER SIMULATORS AND STUDIES RELATED TO SPACE RENDEZVOUS AND DOCKING
Jack E. Pennington [1964] 17 p refs Presented at the 1964 Ann. Meeting of the Armed Forces–NRC Comm. on Vision, Washington, D. C., 23–24 Apr. 1964
(NASA-TM-X-51714) CFSTI: HC $1.00/MF $0.50

The simulation work relating to the rendezvous and docking of two vehicles in space is summarized. Also, current simulators, studies conducted, and visual problems encountered are discussed. Rendezvous, acquisition, intercept, and detection are defined. Experimental results showed that subjects could detect the target when it was as bright as a 4th to 5th maghitude star. This means that the filtering technique does not change the threshold of detection, but by using solar illumination the target could be detected at considerably greater ranges than would be possible using artificial lighting. The visual docking and rendezvous docking simulators are given as examples of closed-circuit television and dynamic simulators. Closed-circuit television permits simulating relatively high velocities and longer ranges, and it is comparatively easy to vary the lighting conditions, but the picture loses fidelity at

close ranges and the minimum range is determined by the distance from the observer to the projection screen. The dynamic simulator gives the pilot the same view he would have from the spacecraft, permits closure to vehicle contact, but encounters difficulty in eliminating visual cues. E.E.B.

N65-22194*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION OF GEMINI-AGENA DOCKING
Byron M. Jaquet and Donald R. Riley [1964] 11 p refs Presented at Meeting No. 14 of Comm. A-18 of SAE Aerospace Equipment Div., New York, 8-10 Jul. 1964
(NASA-TM-X-51802) CFSTI: HC $1.00/MF $0.50

The results from a general study in which a pair of fingertip controllers were used for attitude and translation control are presented. The primary purpose of the study was to obtain information concerning fuel and time required for docking with the primary rate command and the backup direct attitude control modes. Also, the evaluation of the docking phase of two basic attitude control modes and prototypes of actual Gemini hand controllers is reported. The data presented were obtained with the visual docking simulator, a fixed-base type device which employs closed-circuit television to provide full-scale images of the target vehicle. It was concluded that simulators provide a realistic environment to evaluate controllers and control systems of space vehicles. Results demonstrated that successful docking can be accomplished consistently with either the primary rate command mode or backup direct mode. E.E.B.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-21149# California Univ., Livermore. Lawrence Radiation Lab.
PROPAGATION OF DISTURBANCES
J. Hardy 22 Feb. 1965 19 p ref
(Contract W-7405-ENG-48)
(UCRL-12412) OTS: $1.00

In a medium subject to a set of conservation equations, the necessary conditions on the propagation of a disturbance are presented. The evolutionary behavior of disturbances subject to these conditions is also given. Author

N65-21178# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
STUDIES OF THE FLOW CHARACTERISTICS OF A COMPRESSIBLE, BUBBLY MIXTURE ABOUT SUPERCAVITATING BODIES AND IN A CONVERGING-DIVERGING NOZZLE Technical Paper No. 48, Series B
F. R. Schiebe, J. M. Wetzel, and K. E. Foerster Apr. 1964 62 p refs
(Contract Nonr-710(52))
(AD-612025)

Experimental studies were made to determine the effect of a compressible, air-water mixture on the drag characteristics of a cavitating body. Data are reported for a series of conical bodies of various slenderness ratios for free stream Mach numbers up to 0.7. Results indicate that the drag coefficient increases with Mach number, although in general not as rapidly as for a noncavitating body. It was possible to apply Gothert's rule to adequately predict the drag coefficient up to Mach numbers of about 0.6. A brief study was also conducted of the flow characteristics of an air-water mixture in a converging-diverging nozzle. Supersonic flow was obtained and shock waves were observed downstream of the throat. Measured throat pressures for choked flow were somewhat higher than those calculated from homogeneous mixture theory. Author

N65-21190# Martin Co., Baltimore, Md.
AN APPROXIMATE TECHNIQUE FOR COMPUTING NONEQUILIBRIUM FLOWS
Ralph Phinney Feb. 1965 30 p refs
(RM-189)

Two methods are presented that can be used in conjunction with finite rate chemical reactions for computing flows. The first, an iteration technique, gives a satisfactory solution from the first step. The second, an approximate method of integrating the relaxation equation, allows larger step sizes than conventional methods. Examples are given for vibrational and dissociational nonequilibrium in a nozzle in which an exact solution is compared with results of the approximate techniques. Author

N65-21249# Los Alamos Scientific Lab., N. Mex.
THE COMPRESSIBILITY OF GASEOUS MIXTURES OF HELIUM-NITROGEN AND HELIUM-DEUTERIUM AT HIGH PRESSURES
James D. Cramer 24 Mar. 1965 23 p refs
(Contract W-7405-ENG-36)
(LA-3250-MS) CFSTI: $2.00

The compressibilities of gaseous mixtures of helium-nitrogen and helium-deuterium were determined in the pressure range from 100 to 1400 atm at 25° C. The compressibility of pure helium was also determined in the same pressure range at 25° C. The experimental data were fitted to a four-term virial equation by the method of least squares, and the resulting virial coefficients are listed. Some of the experimental compressibility factors are then compared with the corresponding compressibility factors determined by an additive volume method. Author

N65-21266# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics
A MOMENT METHOD FOR COMPRESSIBLE LAMINAR BOUNDARY LAYERS AND SOME APPLICATIONS
Paul A. Libby and Herbert Fox Sep. 1964 42 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-615; AFOSR-64-1786; AD-612081)

An integral method based on moment techniques and especially useful for compressible laminar flows is presented. The describing partial differential equations are first transformed to the Levy-Lees variables and then converted to integral conditions with eta to the mth power as a weighing factor. A technique for handling the variation in transport properties which explicitly arises for $M > 0$ is described. The resultant equations are applied for $M = 0.1$ with the commonly employed fourth and fifth degree polynomial profiles for velocity and stagnation enthalpy. The distinct classification of similar and nonsimilar flows within the same analytic framework is emphasized. The analysis is applied to a variety of flows for which more accurate results are available and is found to yield

satisfactory results in most cases. Therefore, the present method is considered to improve somewhat the conventional integral method (M = 0) without excessive labor. Author

N65-21284*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TRANSIENT PRESSURE RESPONSE IN A FLUID SYSTEM AS A VIBRATING VALVE CLOSES
Cecil A. Ponder, Jr. 5 Feb. 1965 58 p refs
(NASA-TM-X-53206) CFSTI: HC $3.00/MF $0.50

Equations are derived that describe the unsteady flow in a pipeline when a vibrating valve closes; a pressure oscillation occurs in addition to water hammer. The results of analytical and experimental investigations show that the pressure oscillation causes an increase in the maximum transient pressure during valve closure that is proportional to the frequency and amplitude of valve vibration. Because the boundary conditions and natural frequencies may vary, each fluid system must be investigated to determine the relationships between the pressure oscillation and the frequency and amplitude of the valve vibration. The analytical methods reported can be used for such an investigation. Author

N65-21305*# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering
FLUID-DYNAMIC PERFORMANCE OF A CAVITATING VENTURI, PART I
F. G. Hammitt, C. L. Wakamo, P. T. Chu, and V. L. Cramer Oct. 1960 76 p refs *Its* Rept.-03424-2-T
(Grant NsG-39-60; UMRI Proj. 03424)
(NASA-CR-57794) CFSTI: HC $3.00/MF $0.75

A cavitating venturi has application either as a flow-metering or controlling device which is insensitive to downstream pressure, or as a tool for basic research on the nature and behavior of cavitating flows. This report presents qualitative and semi-quantitative measurements and observations describing the nature of such flow. Author

N65-21341# AVCO-Everett Research Lab., Everett, Mass.
FLOW IN A CAVITY AT LOW REYNOLDS NUMBER
R. F. Weiss and B. H. Florsheim Mar. 1965 21 p refs Prepared for Bell Telephone Labs.
(Contracts DA-30-069-ORD-1955; DA-19-020-AMC-0210; ARPA Order 525; Proj. Defender)
(AMP-156; AD-460600)

Approximate solutions are obtained for the flow fields in rectangular cavities by neglecting the convection of vorticity. These solutions yield multicell recirculation regions for high aspect ratio cavities. Water tank experiments at a Reynolds number of 150 confirm the prediction of double-celled cavity flow, and show good agreement with the theoretical cell dimensions. It is inferred that zero Reynolds number solutions have an extensive range of validity in flows with closed streamlines. Author

N65-21355*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics
STABILITY OF A SHEAR FLOW IN AN UNSTABLE LAYER
Thomas J. Eisler Jan. 1965 27 p
(Grant NsG-586)
(NASA-CR-57874; Rept.-65-003) CFSTI: HC $2.00/MF $0.50

The stability with respect to small perturbations of a piecewise linear velocity profile of the half-jet (or shear layer) type in a layer with an unstable entropy gradient was studied. The maximum instabilities are found to be either in the plane of the velocity profile or perpendicular to it, depending on a critical Richardson number which is quite insensitive to the depth of the layer. Author

N65-21356*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics
STABILITY OF TWO-LAYER VISCOUS STRATIFIED FLOW DOWN AN INCLINED PLANE
Timothy W. Kao Sep. 1964 45 p refs
(Grants NsG-586; PHS-WP-00428)
(NASA-CR-57878) CFSTI: HC $2.00/MF $0.50

The stability of flow down an inclined plane is investigated for the case of a stratified fluid system consisting of two layers of viscous fluids of different densities. This problem is an extension of the works of Benjamin and Yih for a homogeneous fluid; thus their results are a special case of the solution for this more general problem. Asymptotic cases for long and short wave length disturbances are considered, and the neutral curve is estimated. Reynolds numbers for the bifurcation point of the neutral curve are found for various ratios of density and depth of the two layers. For long waves, shear wave instability is also studied and found to be damped. For the purpose of comparing the relative stability between different configurations, a stability index is defined. It is found that the two-layer flow is more stable or unstable than the homogeneous case of equal total depth, depending on whether the upper fluid is lighter or heavier than the lower one. The source of instability is to be found in the presence of the interface. It is hoped that this work will bear on problems of flow stabilizing techniques and liquid extraction processes. Author

N65-21401# Michigan Univ., Ann Arbor. Aircraft Propulsion Lab.
A HYDRODYNAMIC THEORY FOR THE INTERACTION OF A GASEOUS DETONATION WITH A COMPRESSIBLE BOUNDARY
Martin Sichel Feb. 1965 45 p refs Submitted for Publication
(Grant DA-ARO(D)-31-124-G-345)
(Rept.-05170-2-T; AROD-3559-2; AD-612929)

Detonations through an explosive of finite width are curved and propagate at a lower velocity than an ideal one-dimensional plane wave. A theory relating the velocity decrement and curvature of a gaseous detonation to the conditions at the explosive inert interface is developed. A two-dimensional detonation bounded on one side by a solid wall and on the other by an inert gas is considered. Approximate reaction zone equations are derived by expanding the flow variables in powers of a small parameter proportional to the ratio of reaction zone thickness to radius or curvature. Locally the reaction zone equations are the same as for one-dimensional flow with increasing area and heat addition, the rate of increase depending on the local wave curvature and the density variation through a plane detonation. Using Fay's result that the relative detonation velocity decrease is proportional to the fractional increase in the reaction zone stream-tube area, an ordinary differential equation for variation of the wave angle is developed. Approximate solutions of the above equation yielded velocity decrements which agreed with experimental results. Author

N65-21404# Mitsubishi Heavy-Industries, Ltd., Nagasaki (Japan). Experimental Tank Lab.
INVESTIGATION INTO THE PROPELLER CAVITATION IN OBLIQUE-FLOW Final Report
Kaname Taniguchi and Noritane Chiba May 1964 42 p refs
(Contract Nonr-4214(00))
(Rept.-1800; AD-612877)

Three propeller models of high speed craft were tested in both axial and oblique-flow conditions in a cavitation tunnel. The test results show that there are decreases in K_T, K_Q, and E_P in oblique-flow condition and that the decreases of K_T and K_Q are approximately proportional to the angle of inclination squared. The cavitation patterns on a blade varied considerably with its angular position due to the local variation of angle of incidence of the blade section. Using these test results, the sea trial results of the corresponding actual boats were analyzed. Considerable improvement was attained in model-ship correlation using the experimental results in oblique-flow condition, compared to the ordinary method using the axial-flow data. Author

N65-21446*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences

A THEORETICAL STUDY OF NONLINEAR FUEL SLOSHING IN AN ELASTIC CIRCULAR TANK

Wen Hwa Chu [1964] 7 p refs

(Contract NASr-94(03); SwRI Proj.-02-1329; 02-1519)

(NASA-CR-62151) CFSTI: HC $1.00/MF $0.50

For the problem of nonlinear fuel sloshing in a tank consisting of an elastic thin cylindrical shell, methods are described for approximating steady-state response and the stability boundary. In the mathematical models considered for description of fluid motion, attention was limited to terms of the first three orders in fluid amplitudes. A theoretical example concerning an upright cylindrical tank filled with a liquid to a depth equal to three-fourths of its length is presented; it is stated that the steady-state amplitudes can be obtained approximately by the method of harmonic balance. Four computer programs are described and compared for computing eigenvalues for the stability equations. J.M.D.

N65-21461*# Brown Engineering Co., Inc., Huntsville, Ala. Mechanics and Propulsion Labs.

ANALYSIS OF FLOW FROM PLUG NOZZLES WITH SECONDARY EJECTOR SYSTEMS

C. G. Lee and S. J. Inman Jan. 1965 85 p refs

(Contract NAS8-5289)

(NASA-CR-62188; R-128) CFSTI: HC $3.00/MF $0.75

The method of characteristics is presented for the calculation of the supersonic flow field, with the Rankine–Hugoniot equations used to compute the flow properties across a shock. The secondary flow properties are calculated by the one-dimensional isentropic relationships. The gas is assumed to be an inviscid nonreacting perfect gas with constant specific heat. Sample calculations, as well as the listing of the Fortran program, are presented. Author

N65-21496# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

VISUAL OBSERVATIONS OF FLUID BEHAVIOR IN HIGH-PRESSURE TRANSITION BOILING FLOWS

E. P. Quinn and C. L. Swan May 1964 53 p refs

(Contract AT(04-3)-189)

(GEAP-4636)

Preliminary motion pictures are included of high-pressure, two-phase, forced fluid flow behavior at the surface of a heated rod during the critical flux condition, in transition boiling, and for film boiling. Short, finned, heated surfaces were found to nearly eliminate transition boiling wall temperature fluctuations and improve film boiling heat transfer without a reduction in critical heat flux. Loop two-phase flow disturbances were found to cause excessive transition temperature fluctuations. Author

N65-21541# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MIXING OF JETS IN A CHANNEL WITH VARIABLE CROSS-SECTION

O. V. Yakovlevskiy 17 Jan. 1963 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1962 p 66–72

(FTD-TT-62-1571/1+2+4; AD-295809)

In gas machines, currents are encountered with nonuniform profiles of gasdynamic parameters, e.g., velocity, this nonuniformity gradually smoothing out downstream. Similar flows are observed in the mixing chambers of ejectors and in circuit jet engines. In some practical cases these flows occur in channels, the form of which differs from the cylindrical, i.e., in channels with variable cross section. The methods of calculating the parameters of a nonuniform stream in a channel of arbitrary shape have not yet been established. There exists only the monograph of Cherkez on a theory devoted to flow in the cylindrical blending chamber of an ejector. An attempt is made to devise a method of calculating the flow of a fluid with nonuniform velocity distribution of the jet type in a channel with variable cross section. Author

N65-21640*# General Dynamics/Astronautics, San Diego, Calif.

AN APPROXIMATE NONLINEAR ANALYSIS OF THE STABILITY OF SLOSHING MODES UNDER TRANSLATIONAL AND ROTATIONAL EXCITATION

T. R. Rogge and H. J. Weiss Washington, NASA, Apr. 1965 67 p refs

(Contract NAS8-11193)

(NASA-CR-220) CFSTI: HC $3.00/MF $0.75

This paper considers the irrotational motion of an incompressible, inviscid fluid contained in a partially filled tank. The tank is subjected to both transverse and rotational vibrations whose frequencies are near the first natural frequency of small free-surface oscillations. Following a method suggested by Hutton, the analysis is performed retaining higher order terms in the free-surface dynamic and kinematic boundary conditions. The theoretical investigation predicts the forcing frequency ranges, for various combinations of rotational and translational motion, over which there are stable, steady-state, harmonic, planar, and nonplanar motions. The least stable case occurs when a combination of motions occurs in mutually orthogonal planes. Author

N65-21642*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SHADOWGRAPH STUDY OF THE UPPER STAGE FLOW FIELDS OF SOME SATURN V STUDY CONFIGURATIONS IN THE TRANSONIC MACH NUMBER RANGE

C. Dale Andrews and David R. Carlson Washington, NASA, Apr. 1965 28 p refs

(NASA-TN-D-2755) CFSTI: HC $2.00/MF $0.50

This report presents graphical engineering interpretations of selected shadowgraphs. The photographs were obtained during transonic wind-tunnel tests of two preliminary Saturn V study configurations. The engineering interpretations are qualitative aids in the evaluation of space vehicle aerodynamic data in the critical transonic Mach number range. The interpretations show the effects of Mach number, angle-of-attack, and launch escape-system spikes on the flow fields about the unconventional Saturn upper stage shapes. Background information is given on the pictorial fidelity, problems of interpretation of shadowgraphs, separable Reynolds and Mach number effects, spike effects, and shock–boundary-layer interactions. A detailed discussion dissects the sample interpretations and lists characteristics of typical flow fields. Author

N65-21695# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Thermodynamics and Propulsion

CHEMICAL NONEQUILIBRIUM IN SUPERSONIC NOZZLE FLOWS

D. Migdal Dec. 1964 33 p refs
(ADR-01-10-64.1)

Realistic analyses of nozzle flows include the combined effects of wall shape and chemical reactions in the supersonic portion of the nozzle. A relatively simple tool which preserves the important flow features utilizes the method of characteristics in conjunction with an approximate chemical kinetic analysis. In this solution the flow along streamlines is assumed to be in complete equilibrium until a sudden freezing point is reached. The consistent use of this approximation requires that the nonequilibrium terms be neglected in the characteristics solution and that the equilibrium sound speed be used up to the freeze point. The two-dimensionality of the flow is preserved by allowing different freeze point locations among streamlines. Ten recombination reactions were chosen to represent most propellants containing combinations of carbon, fluorine, hydrogen, nitrogen, and oxygen. Comparisons of the results of this analysis with more exact kinetic solutions and experimental data show good agreement. Author

N65-21746# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

THE PROPAGATION OF SMALL DISTURBANCES IN REAL GASES

Wilbert J. Lick Oct. 1964 63 p refs
(Grant NSF GP-414)
(TR-9)

The one-dimensional propagation of small disturbances through a gas considering the effects of viscosity, thermal conductivity, chemical reaction, diffusion, and radiation is investigated. The purpose is to clarify the similarities and differences between these various phenomena. The signaling problem is studied in detail. A qualitative discussion of the nonlinear signaling problem including real-gas effects and based on the linear theory is given. Author

N65-21787# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.

A GENERAL THEORY OF STABILITY OF THE MOTION OF A FLUID WITH HEAT TRANSPORT AND ARBITRARY FORCE FIELDS

Richard L. Moore 14 Nov. 1964 61 p refs
(Rept.-31964)

By a method due to Rosseland, the equations of a fluid with nonuniform density and heat addition are reduced without approximation from six equations in six unknowns (by eliminating the density and pressure) to obtain four equations in the four unknowns—the temperature field and the three components of the velocity field. This applies to a perfect gas or a Prim gas. Conditions are obtained for the stability of a dissipationless cylindrical plasma with a Gaussian radial density distribution. The vector wave equation which is derived is applied to (1) MHD waves, (2) electron oscillations in a uniform magnetic field, (3) waves in stratified fluids, and (4) the stability of Poiseuille flow. Agreement with the standard results are found for (1), (2), and (3). A theorem on the mechanism for the generation of waves in (3) is obtained. The Orr–Summerfeld equation is found to be inapplicable for the Poiseuille flow of a fluid with an equation of state, and a more general equation is obtained. Theorems for the generation of vorticity have been proved; of particular interest is a theorem for the second time derivative of the circulation which points up the importance of the solenoids of the following quantities: (1) temperature and velocity divergence, (2) force potential and velocity divergence, and (3) heat addition and density. Author

N65-21796# California Univ., Livermore. Lawrence Radiation Lab.

ON MOVING POINT SINGULARITIES

Maurice Neuman 4 Mar. 1965 12 p
(Contract W-7405-ENG-48)
(UCRL-12356) CFSTI: $1.00

A simple heuristic scheme for handling the motion of point singularities is applied to isentropic fluid flow and heat conduction. The coordinates (x,t) of the point singularity, moving on the x axis, are given by

$$O(t)(x) = x - z(t) = s = 0,$$

where x can be referred to the point singularity as origin by means of a parameter. The point is singular because a field quantity keeps jumping across it, and the jump in the field depends on the jump in the derivative of the field. A system of chained laws of motion for jumps of arbitrary order is obtained that may involve an infinite number of variables; a cut in the chain is sometimes possible. The case of a characteristic singularity (sonic case) turned out to be simple; a finite number of variables was sufficient to specify the motion. Cases of noncharacteristic singularities (thermal cases) needed an infinite number of variables. G.G.

N65-21858# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.

EFFECT OF ABLATION MATERIAL AND NOSE BLUNTNESS ON OBSERVABLES FROM A SLENDER CONE IN A FREE-FLIGHT RANGE

R. I. Primich, M. Steinberg, L. N. Wilson, R. A. Hayami, E. W. Evans et al Dec. 1964 72 p refs
(Contract DA-01-021-AMC-11359(Z); Proj. Defender)
(TR64-60; AD-457367)

A study made of the effects upon radar and optical observables of the injection of specific seeded ablation materials into the wake flow behind hypersonic conical bodies was carried out in a free-flight range, using 12.5 degree conical models of varying nose bluntness at two ambient pressures. A clean model and range configuration was first established to serve as a low-observable baseline from which to assess enhancement resulting from the various parametric changes. It was found in general that ablation products enhanced both ionization and radiation observables in the wake, with the rate of decay of both being closely coupled to the location of transition and the onset of rapid turbulent wake mixing. The addition of seed material in the ablator increased the ionization levels, but in general had little effect on all other observables. A detailed discussion of the results is made. Author

N65-21862# Royal Aircraft Establishment, Farnborough (England).

FLOW SEPARATION IN THREE DIMENSIONS

E. C. Maskell London, Min. of Aviation, Nov. 1955 21 p refs
(RAE-AERO-2565)

A generalized concept of flow separation is presented, and the conditions in the neighborhood of a line of separation are deduced. The resulting flow is shown to be composed of two basic elements, the free vortex layer and the bubble, each of which is identified by a characteristic pattern formed in the solid surface by the family of limiting streamlines. From the results of the analysis the physical structures of possible three-dimensional flows are readily inferred. Author

N65-21869# Royal Aircraft Establishment, Farnborough (England).
SOME EFFECTS OF STABLE COMBUSTION IN WAKES FORMED IN SUPERSONIC STREAM
L. H. Townend London, Min. of Aviation, Mar. 1963 28 p refs
(RAE-TN-AERO-2872)

In a wind-tunnel flow of Mach 2.14, hydrogen gas was bled into the wake flows formed by a strut-mounted cone-cylinder of 1-inch diameter, with a blunt base and conical afterbodies of semiangles 30° and 22 1/2°. Combustion of hydrogen in the form of diffusion flames has been stabilized in these wakes, and a consequent reduction in base drag demonstrated, the increased base pressure in some cases slightly exceeding the local upstream static pressure on the cylindrical surface. Measurements were obtained for peripheral and axial injection, of hydrogen (without combustion) and of nitrogen, into the wake of the blunt base. Some data have been correlated by evaluation of an appropriately defined specific fuel consumption. Author

N65-21885# ARO, Inc., Arnold Air Force Station, Tenn.
CONSIDERATIONS IN THE MEASUREMENT OF CRYOPUMPING CAPTURE COEFFICIENTS
J. D. Haygood and J. P. Dawson Arnold Eng. Develop. Center, Apr. 1965 31 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-68; AD-461132)

A survey is presented of the more important practical and theoretical relationships involved in the study of cryopumping. Starting with a rigorous definition of the capture coefficient, the effects of temperature on the measured values are derived. Several practical points in the design of a chamber for cryopumping measurements are given, including cryosurface and gage placement, calibration, effects of outgassing and impurities, and temperature measurements. Author

N65-21930# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
THE COUPLING OF VIBRATIONAL RELAXATION AND DISSOCIATION
M. Greenblatt 1964 61 p refs
(VKI-TN-19)

The coupling of vibrational relaxation and dissociation behind strong shock waves is discussed. The flow for various coupling models is calculated, with the CVDV model of Treanor and Marrone, giving the most reasonable description of the process. The effects of various parameters are indicated, including the uninhibited dissociation rate, and the upstream Mach number, temperature and pressure. Author

N65-22016# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
AN EXPERIMENTAL STUDY OF TURBULENT BOUNDARY LAYER STRUCTURE Final Report
E. J. Plate and V. A. Sandborn Dec. 1964 49 p refs
(Grant DA-SIG-36-039-62-G24)
(CER64EJP-VAS37; AD-612168)

The report covers work done in preparation for a systematic investigation of the nature of aerodynamic roughness, and of the effect of thermal stratification on the turbulence structure in forced convection environments over rough and smooth surfaces. The investigations are based on data taken in a meteorological wind tunnel. After completion of the tunnel check out, exploratory measurements were made of the distributions of velocity and temperature in a thermally stratified flow (of unstable stratification) and of the velocity profiles above small sample plates covered with different types of sand roughness. A study of the flow of air over flexible roughness was the first comprehensive study which lead to definite conclusions. While the wind tunnel was readied for experimental work, side studies were undertaken for developing techniques for measuring profiles of mean velocities and mean temperatures, and for measuring fluctuations of temperature and of velocities. TAB

N65-22029# Technion Research and Development Foundation, Ltd., Haifa (Israel).
ANALYSIS OF THE NEAR WAKE PRESSURE IN SUPERSONIC FLOW USING THE MOMENTUM INTEGRAL METHOD Interim Scientific Report No. 5
Josef Rom (Technion-Israel Inst. of Tech.) Sep. 1964 44 p refs
(Contract AF 61(052)-576)
(TAE-35; AD-611817)

The pressure of two-dimensional base type separated regions is evaluated by use of semiempirical analysis. The analysis is based on the momentum integral method. Empirical parameters required in the analysis are evaluated from various available experimental data. Good correlation over a large range of variation of the physical parameters is obtained in the case of two-dimensional supersonic flows for both laminar and turbulent separation over backward facing steps and blunt bases. The axially symmetric base type flows seem to be affected by the inviscid axially symmetric external flow in a different manner than in the two-dimensional case. It seems that the parameters applicable for the two-dimensional base type flows are not sufficient for the correlation of the axially symmetric separated flows. Author

N65-22050# New York Univ., N. Y. Courant Inst. of Mathematical Sciences
A UNIFORMLY VALID ASYMPTOTIC THEORY OF RARIFIED GAS FLOWS UNDER THE NEARLY FREE-MOLECULE CONDITIONS
Young-ping Pao 18 Dec. 1964 132 p refs Work done in cooperation with Princeton Univ.
(Contract AF 49(638)-1271; Grant AF-AFOSR-62-266)
(MF-43; AFOSR-65-0276; AD-612079)

An asymptotic theory for obtaining nearly free-molecule solutions which are uniformly valid throughout the flow field of an infinite rarefied gas is proposed in the present study for the linearized Boltzmann equation with hardsphere molecules. Power-law molecules can be treated in a like manner. The theory is based on a new integral formulation of the linearized Boltzmann equation. An inner-and-outer-expansion procedure is used. The simplification in the inner region is that the collisional effects are only secondary while outside of the inner region the angle subtended by the body is small so that the flow field is essentially that created by a source at the origin. In order to examine the mathematical nature of this asymptotic theory, a two-dimensional circular cylinder rotating in a rarefied gas, which is at rest at infinity, is studied. It is proved that the inner and outer solutions obtained by the theory are indeed asymptotic to the true solution throughout the physical space. TAB

N65-22052# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE THEORY OF CLASSICAL FLUIDS—V
Loup Verlet Mar. 1965 28 p refs
(TH-92)

Percus' method was used to derive expressions for the chemical potential and integral equation for the correlation functions of classical fluids. An expression has been found for the chemical potential in terms of correlation functions possessing strong cluster properties. It has been shown that the expansion originally considered by Percus is in fact made in terms of the direct correlation function. It is shown that the P Y II equation, is an improvement of the P Y equation using Percus' method. Author

N65-22057# National Aeronautical Lab., Bangalore (India).
THE USE OF SPLITTERS FOR FLOW CONTROL IN WIDE ANGLE CONICAL DIFFUSERS
D. M. Rao and K. N. Raju Dec. 1964 22 p refs
(TN-AE-26-64)

This report describes the work carried out in continuation of the preliminary tests on the use of splitters for flow control in a wide angle conical diffuser and deals with experiments aimed at identifying the flow mechanism responsible for the success of the splitters. Flow visualization tests revealed the existence of a large trapped vortex in each pocket of the eight-vane splitter in all cases where a stable diffuser flow with relatively uniform exit profile was achieved. The qualitative relationships between the splitter geometry, vortex location and the exit profile uniformity were established, and the effect of inlet flow turbulence was briefly investigated. For optimized splitter configurations, pressure loss measurements indicated that efficiency approaching 50% is attainable for the 38° conical angle, area ratio 15 diffuser model tested. Author

N65-22078# Oceanics, Inc., Plainview, N. Y.
THE INFLUENCE OF FREE AIR BUBBLES ON CAVITY VOLUME AND THE ASSOCIATED NOISE SIGNATURES
August F. Lehman Aug. 1964 67 p refs
(Contract NObs-88547)
(Rept. 64-14; AD-611167)

The series of investigations concerned a study of cavity volume and how the volume was affected by the presence or absence of free air bubbles in the test stream. The cavity was of an intermittent type created when a specially designed propeller passed through a reduced flow region (wake). The size or volume of cavity investigated was such that the largest had a volume greater than 30 times the smallest. In conjunction with the volume studies, measurements were made of the noise characteristics of the cavities employing one third octave analysis. Key conclusions are: (A) free gas bubbles in the water significantly affect the cavity volume, (B) the cavity volume generally appears to be directly associated with the amplitude of the noise signature for a given water condition, (C) bubble-filled water tends to produce smaller signature amplitudes than bubble-free water, (D) the higher frequencies (10 kc and above) are superior to lower frequencies in detecting the existence of cavitation (not including distance considerations). Author

N65-22084# Texas Technological Coll., Lubbock. School of Engineering
SIMPLIFICATION OF FLUID-FLOW COMPUTATIONS FOR ORIFICE METERS
Eugene Byron Catherman (M.S. Thesis) May 1965 58 p refs
(Contract AF 33(608)-1119)
(AD-611790)

This report presents the derivation of the H number—for use with the thin-plate orifice fluid-flow meter with vena contracta taps. The arduous task of velocity determination was circumvented by elimination of the Reynolds number in calculation of mass flow rate. Further simplification was attained by use of a digital computer program to realign extensive experimental data, enabling a tabular and graphic presentation of the three dimensionless parameters. Use of these three parameters permits convenient determination of the mass flow rate through knowledge of the easily measured factors contained in the H number. Determination of the items normally associated with measurement of fluid-flow by an orifice-meter (i.e., the velocity of approach, coefficient of discharge, and flow coefficient) was eliminated, resulting in a more simplified method of analysis. Author

N65-22087# Dartmouth Coll., Hanover, N. H.
PVT RELATIONS IN SOLID He^3 AND SOLID He^4-FLOW MEASUREMENTS WITH SUPERFLUID HELIUM Final Report, 1 Oct. 1962–31 Dec. 1964
John N. Kidder 11 Feb. 1965 9 p refs
(Grant AF-AFOSR-74-63)
(AFOSR-65-0387; AD-611763)

The gravitational flow of superfluid helium through "large" (internal diameter greater than 0.01 cm) capillaries at 0.4° K has been studied. The primary purpose of this experiment was to find the form of the pressure gradients as a function of fluid velocity. As expected, a critical velocity, below which the pressure gradient was zero, was observed. Over a small range of velocities the pressure gradient varied nearly linearly with velocity, and at higher velocities it varied as the velocity squared. We are attempting to explain these results in terms of the creation of vortex rings at the capillary wall. The experiments are being continued with straight glass capillaries instead of spiralled metal ones in hopes of obtaining more consistent results. An improved apparatus has been developed to continue measurements begun at Yale University with Air Force support on the PVT relations in solid helium (AD-408 479). Microwave cavities are being used to measure the pressure as well as the density. An experiment to study the propagation of second sound in rotating rectangular resonators is also described. We hope to measure the magnus force on superfluid vortices by this technique. Author

N65-22096# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL INVESTIGATION OF STABILITY CHARACTERISTICS OF UNSTEADY LAMINAR BOUNDARY LAYER
Yasujiro Kobashi and Akira Onji 1964 16 p refs In JAPANESE; ENGLISH summary
(NAL-TR-65)

To determine a stability criterion of small disturbances in a boundary layer with a time-dependent outside flow, experimental studies were carried out in a wind tunnel with a 20 cm by 15 cm cross section, in which the flow speed was forced to oscillate sinusoidally around its mean value. The results are summarized as follows: The boundary layer velocity profiles and their stability characteristics vary with the phase of the outside flow, and are related to unsteadiness parameters $\Delta U/U_m$ and ω_x/U_m. As long as these parameters are small, the stability of the disturbances is related to the instantaneous boundary layer profiles. Author

N65-22152# Technical Research Group, Inc., Melville, N. Y.
THEORETICAL STUDY OF RESONANT STIFFENING DEVICES
David Yarmush Apr. 1964 270 p
(Contract Nonr-3208(00))
(TRG-142-TN-64-10; AD-611564)

The vibration properties of a plate or a rod with attached mechanical structures, called resonators, are studied by transfer matrix and Green's function techniques. The plate may be

in a vacuum, or acoustically coupled to water on one side. The effects of an added resonator at a given frequency depend only on its response strength in each of its modes of vibration. Expressions are derived for the strengths of several useful resonator types. Boundary conditions for the plate, such as clamping or simple support, are satisfied by the mathematical device of attaching resonators of infinite strength. A piston cut out of the plate material is handled similarly. Formulas for the interactions "influence coefficients" between the modes of different resonators are given. Expansions are developed for the transcendental integrals that arise in the problems treated.
Author

N65-22160# Space Technology Labs., Inc., Redondo Beach, Calif.
TURBULENT DIFFUSION OF A REACTING WAKE
Wilmot H. Webb and Leslie A. Hromas 3 Dec. 1964 50 p refs Presented at AIAA Ann. Meeting, 30 Jan. 1964 Revised
(Contract AF 04(694)-440)
(STL-6453-6012-KU-000; BSD-TR-64-342; AD-611100)

Properties of the nonequilibrium hypersonic turbulent wake have been calculated from an integral solution for the coupled diffusion of mass and energy. Emphasis is placed on: a comparison of a slender body calculation from the present simple method with results obtained for the same case by more advanced mathematical techniques such as finite difference methods; new blunt body results in which the reacting inviscid flow is entrained by the turbulent inner wake; the effect of contaminants on both slender and blunt body wakes; and a comparison of the present calculations with ballistic range measurements for wake velocity and electron density. TAB

N65-22179* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSPORT PROPERTIES OF DILUTE GAS MIXTURES
Richard S. Brokaw [1964] 26 p refs Presented at the NSF Intern. Seminar on Transport Properties of Gases, Brown Univ., 20–24 Jan. 1964
(NASA-TM-X-51726) CFSTI: HC $2.00/MF $0.50

Experimental transport properties of five binary systems (helium–argon, helium–hydrogen, hydrogen–nitrogen, argon–ammonia, and hydrogen–ammonia) were investigated in terms of the best available theoretical formulations. The analysis indicates that (1) the diffusion coefficients and viscosities of gas mixtures, including mixtures with polyatomic and polar molecules, can be well described by the Chapman–Enskog theory; (2) the Chapman–Enskog theory is probably valid for the thermal conductivity of mixtures of monatomic gases, although none of the experimental data was good enough for a definitive test of the theory; and (3) approximate methods accounting for the effects of internal energy on the heat conductivity of mixtures involving polyatomic and polar gases seem promising but could not be fully evaluated. It is concluded that there is no need for further experimentation to obtain mixture data of modest accuracy and precision because rigorous determinations are necessary for really meaningful tests of theory. The almost total lack of precise thermal conductivity data is stressed, and it is proposed that such data may be acquired from precise measurements relative to the noble gases.
M.P.G.

N65-22186*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MOTION OF GASEOUS STREAMS IN THE BINARY SYSTEM
Su-shu Huang (Catholic Univ. of Am.) [1964] 22 p refs Submitted for Publication
(NASA-TM-X-51701) CFSTI: HC $1.00/MF $0.50

Several problems in connection with the gaseous flow in the close binary system were studied. First, the statistical property of the Jacobian constants of colliding particles in the system is examined, and a conservation law for their mean value established. Then the velocity-independent nature of the rate of change in angular momentum of a particle moving in the binary system is pointed out. A set of differential equations for the gaseous flow is derived that provides a point of view lying in the middle between the orbital approach and the hydrodynamic approach because these equations take into account the collision, but not the pressure. The equations were solved under the same approximation as Prendergast (1960) assumed, and were found to yield a result similar to the one he obtained from the hydrodynamic equations. The formation, the evolution, and the significance of rotating rings observed in many Algol-type eclipsing binaries are discussed in an effort to understand the mode of ejection of matter from the secondary surface.
Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-21169# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
DIRECT SATELLITE PROBE MEASUREMENTS OF IONOSPHERIC IRREGULARITIES IN THE F REGION AND THE POLAR CAP
J. C. Ulwick, W. Pfister, and R. E. Mc Inerney Dec. 1964 28 p refs *Its* Environ. Res. Papers No. 74
(AFCRL-64-1021; AD-612650)

A standing wave impedance probe has been flown on polar orbiting satellites through the F_2 layer. Continuous measurements for entire orbits were recorded and stored on magnetic tape. The data were processed and plotted completely automatically from the telemetry magnetic tapes. In studying the profiles through the F region interesting irregularities were found superimposed on the gross features of the ionosphere. Irregularities were noted of a size in the order of 400 km with the small-scale density fluctuations between 5% and 10%. There is a tendency of these irregularities to be larger in the vicinity of the magnetic equator. Of special interest is irregular structure observed in the south polar region above the peak of the F layer. The satellite passes through the region at the same local time but covers the whole region geographically in the course of a day. One system of irregularities appears to be alined with the magnetic latitude, while another structure appears consistently at a geographic latitude near 70°.
Author

N65-21227*# National Aeronautics and Space Administration, Washington, D. C.
ATTENUATION OF TOTAL RADIATION IN UPPER LAYER CLOUDS [OSLABLENIYE SUMMARNOY RADIATSII OBLAKAMI VERKHNEGO YARUSA]
Ye. P. Novosel'tsev Apr. 1965 12 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 90–95
(NASA-TT-F-322) CFSTI: HC $1.00/MF $0.50

The article considers the attenuation of total radiation of ice clouds in the upper layers for different turbidities of the atmosphere below the clouds, and for different values of the albedo of the base surface. The instantaneous and 24-hour average attenuation coefficients are determined for the attenuation of total radiation produced by the clouds of the upper-layer. Author

N65-21229*# National Aeronautics and Space Administration, Washington, D. C.
MEASURING RADIATION BALANCE AT SEA [OB IZMERENII RADIATSIONNOGO BALANSA V MORSKIKH USLOVIYAKH]
N. Ye. Ter-Markaryants and D. L. Grishchenko Apr. 1965 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 110–125
(NASA-TT-F-324) CFSTI: HC $1.00/MF $0.50

The article presents the results of investigating balance meters with polyethylene coatings of various forms under different meteorological conditions. Some errors are examined which occur when the radiation balance is measured at sea. Recommendations are presented for carrying out the most accurate measurements of radiation balance at sea. Author

N65-21230*# National Aeronautics and Space Administration, Washington, D. C.
CUVETTE FOR NEPHELOMETRIC MEASUREMENTS WITH HIGH ANGULAR RESOLUTION IN THE REGION 5 TO 175° [KYUVETA DLYA NEFELOMETRICHESKIKH IZMERENIY S VYSOKIM UGLOVYM RAZRESHENIYEM V OBLASTI UGLOV 5–175°]
O. I. Golikova Apr. 1965 16 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 176–185
(NASA-TT-F-327) CFSTI: HC $1.00/MF $0.50

An evaluation is made of the errors in nephelometric measurements when rectangular and cylindrical cuvettes are used. On the basis of these investigations, a double cylindrical cuvette is proposed for nephelometric measurements with high angular resolution in the range of 5° to 175°, in particular for investigating the scattering of light by prototypes of cloud droplets. Author

N65-21238# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN THE ARCTIC
I. M. Dolgin et al 7 Apr. 1965 35 p refs Transl. into ENGLISH from Probl. Arktiki i Antarktiki (Leningrad), no. 11, 1962 p 31–36, 65–79, 91–95
(JPRS-29482; TT-65-30675) CFSTI: $2.00

CONTENTS:

1. SOME RESULTS OF ATMOSPHERIC RESEARCH OVER THE ARCTIC OCEAN I. M. Dolgin p 1–8 refs
2. RESULTS OF GEOPHYSICAL INVESTIGATIONS IN CENTRAL ARCTIC V. S. Ignatov p 9–21 refs
3. LATITUDINAL SHIFTS IN ZONE OF TURNING (REVERSAL) OF DIURNAL VARIATIONS OF THE MAGNETIC FIELD IN THE ARCTIC N. A. Milyayev p 22–28 refs
4. RESULTS OF THE GEOLOGICAL STRUCTURAL STUDIES OF THE EARTH'S CRUST IN THE CENTRAL ARCTIC BY GEOPHYSICAL METHODS R. M. Demenitskya, A. M. Karasik, and Yu. G. Kiselev p 29–37 refs

N65-21251# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Environmental Research Branch
EXCHANGE RATES OF RADIOACTIVE TRACERS BETWEEN THE ATMOSPHERE AND SNOW
P. J. Barry Mar. 1965 14 p refs Presented at the 1st Can. Conf. on Micrometeorol., Toronto, 12–14 Apr. 1964
(AECL-2232) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Radioactive tracers were released 0.5 m above the snow-covered surface of a flat area, and air and surface samples were collected at several cross wind points 100 m from the source. The total surface drag coefficient was calculated from wind profiles at heights from 15 to 200 cm, and the mass transfer coefficient was calculated from the flux of matter across the boundary and the concentration and wind speed at 30 cm. The flux was found from the accumulation on the surface of the tracers, and tritiated water and radioiodine vapor. The results of the experiments are presented and the correlation between the form drag coefficient and the Reynolds number of the flow are expressed in the equation:

$$C_F = 1.5 \times 10^{-3} (u_* Z_0/\nu)^{0.35}.$$

This new model avoids the theoretical problems raised by the boundary layer, is quite independent of atmospheric stability, and provides for a smooth progression of mass, heat, and momentum exchange from smooth to rough surface. G.G.

N65-21275# Ohio State Univ., Columbus.
AN INVESTIGATION OF FEASIBLE METHODS OF MEAN ELEVATION DETERMINATION FOR GEODETIC APPLICATION
Merlin Chapman Smith, Jr. (M.S. Thesis) 1963 76 p refs
(Contract AF 23(601)-3549)
(AD-417067)

The research demonstrates that the point value average is a feasible method for use in mean elevation determination. It is concluded that with an accurate topographic map of suitable scale, conscientious observers, and efficient working conditions, accurate mean elevations can be economically and accurately determined. As the work is extremely tedious, only a certain type of person can do it; research should be undertaken to devise ways of predicting a person's aptitude for this work. Author

N65-21279# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
EVOLUTION OF RADIOACTIVE MATERIAL IN THE TERRESTRIAL ENVIRONMENT OF ARGENTINA [ESTUDIO DE EUOLUCION DE MATERIALES RADIOACTIVOS EN EL MEDIO TERRESTRE]
Dan Beninson, Eric Vander Elst, and Esteban Ramos 1964 24 p refs In SPANISH
(Rept.-133)

Radioactive contamination of the terrestrial environment of Argentina comes from extraterrestrial sources and nuclear test fallout. The concentration of radioactive fission products in the atmosphere, soil, vegetation, food, and human bones and teeth is measured. Tables are included giving the level of concentration of strontium 90 in the atmosphere over a 5-year period, in various plants, and in the bones and teeth of children of various ages. F.E.R.

N65-21285# National Academy of Sciences—National Research Council, Washington, D. C. U. S. Committee for IQSY
UNITED STATES PROGRAM FOR THE INTERNATIONAL YEARS OF THE QUIET SUN 1964–1965 Interim Progress Report
Martin A. Pomerantz Mar. 1965 47 p refs

This supplement to the revised edition of the U.S. program for the International Years of the Quiet Sun (IQSY) 1964–1965 presents a variety of individual reports pertaining to the disciplines of World Days, Meteorology, Geomagnetism, Aurora and Airglow, Ionospheric Physics, the Sun and the Interplanetary Medium, Cosmic Rays, and Aeronomy. Included is a preliminary bibliography for the IQSY. G.G.

N65-21287# National Academy of Sciences—National Research Council, Washington, D. C. Committee for the IQSY
UNITED STATES PROGRAM FOR THE INTERNATIONAL YEARS OF THE QUIET SUN 1964–1965
M. A. Pomerantz Mar. 1965 62 p Revised ed.

Topics covered include world days, meteorology, geomagnetism, aurora, airglow, ionospheric physics and radio astronomy, the sun and the interplanetary medium, cosmic rays and geomagnetically trapped radiation, aeronomy, and world data centers. L.S.

N65-21297# National Oceanographic Data Center, Washington, D. C.
EQUALANT I, VOL. I Data Report
Albert M. Bargeski and Daniel Roberts, III, comp. 1964 291 p refs
(G-3, Vol. I) Available from Natl. Oceanog. Data Center: $5.00

Data and observations from the multiple-vessel international oceanographic survey are presented for the period February through March 1963. Measurements and samples for selected physical, chemical, biological, meteorological, geological, and geophysical properties of the tropical Atlantic Ocean were investigated and are presented in tables. Most common observations were: hydrographic casts, bathythermograph data, and meteorological-, bathymetric-, carbon 14-, microbiomass-, zooplankton-, and night light collections. Special current studies, and bottom trawling and dredging observations were undertaken by some of the vessels. A table summarizes the data and programs of all participating ships. G.G.

N65-21298# National Oceanographic Data Center, Washington, D. C.
EQUALANT I, VOL. II Data Report
Albert M. Bargeski and Daniel Roberts, III, comp. 1964 796 p
(G-3, Vol. II) Available from Natl. Oceanog. Data Center: $5.00

The oceanographic station data and associated digitized bathythermograph data collected during 1963 in the tropical Atlantic Ocean by ships from various nations are presented in tables. Among the parameters observed were depth to bottom; maximum depth of samples; wave direction, height and period; sea amount; weather; water color; wind direction; salinity; and chemical concentration. G.G.

N65-21330*# International Space Corp., Melbourne, Fla.
AN ANALYSIS OF PROJECT HIGH WATER DATA
David D. Woodbridge and James A. Lasater 6 Mar. 1965 88 p refs *Its* Rept. No. 03.01
(Contract NASw-958)
(NASA-CR-57946) CFSTI: HC $3.00/MF $0.75

The two Project High Water experiments produced optical, ELF, radio frequency, and radar data essential to understanding the effects of data releases of large quantities of water in the ionosphere. Extensive cross correlations were found between the various frequencies of acquired electromagnetic data. These data were analyzed and a physical model of the expansion process developed. Results of the analyses demonstrate that: (1) Extremely low temperatures will be generated by the evaporation–condensation–sublimation processes. These temperatures will depend upon the type, and quantity of liquid released, and upon the ambient conditions into which the release is made. (2) The maximum velocity of the expanding ice-water cloud approximated 1.83 km/sec. However, a perturbation wave associated with the liquid release possessed a velocity as high as 3.60 km/sec. (3) Considerable turbulence is associated with the sudden release of liquids into space. (4) Telemetry attenuations can result from inhomogeneous regions within the ionosphere. (5) Considerable doubt was raised concerning the possible existence of ice in space. The attenuation effects were found to be both frequency and directionally sensitive. Thus, electromagnetic observations provide a technique for investigating inhomogeneous regions in the ionosphere. Author

N65-21332*# State U. of Iowa, Iowa City. Dept. of Physics and Astronomy
ADIABATIC MOTIONS OF CHARGED PARTICLES IN A DIPOLE MODEL OF THE MAGNETOSPHERE
Edward W. Hones, Jr. Mar. 1965 23 p refs *Its* Rept.-65-6
(Grant NsG-233-62)
(NASA-CR-57944) CFSTI: HC $1.00/MF $0.50

The use of the first and second adiabatic invariants of charged particle motion in calculating the trajectories of particles drifting in combined magnetic and electric fields is discussed. Such calculations become particularly simple for a dipole magnetic field if the magnetic lines of force are electric equipotentials. Author

N65-21345*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies
A CONTAMINATED METEORITE
Edward Anders, Eugene R. Du Fresne, Ryoichi Hayatsu, Albert Cavaille (Musee D'Histoire Naturelle de Montauban, France), Ann Du Fresne (Georgetown Univ.) et al Sep. 1964 26 p refs Submitted for Publication
(Grant NsG-366)
(NASA-CR-57912; EFINS-64-46) CFSTI: HC $1.00/MF $0.50

One stone of the Orgueil meteorite shower contains an assortment of biogenic materials: coal fragments, seed capsules of the reed *Juncus conglomeratus*, other plant fragments, and an optically active, water-soluble protein material resembling collagen-derived glues. This sample seems to have been accidentally or deliberately contaminated shortly after the fall of the meteorite in 1864. Author

N65-21358# Joint Publications Research Service, Washington, D. C.
CORRELATION ANALYSIS IN SEISMIC PROSPECTING
V. S. Voyutskiy 12 Apr. 1965 6 p refs Transl. into ENGLISH from Razvedka i Okhrana Nedr (Moscow), no. 2, Feb. 1965 p 29–31
(JPRS-29524; TT-65-30702) CFSTI: $1.00

Over 1000 km of seismogram profiles were run on an analog computer of the continuous-action type, using the correlation method (or the asynchronous accumulation method) of reporting, to determine the possibility of tracing the deep-lying basement. Accumulation and ordinary records are compared. Accumulation channel records show the continuing

process of accumulation noted by deflection of the galvanometer downward from the zero line. Sharp intensity changes recorded on the galvanometer correspond to the arrival of different waves or wave groups at the seismic detector location. First and subsequent arrivals of deep waves can be detected at 9.75, 11.55, 12.65 and 14.65 seconds much more clearly by accumulation than by ordinary records. The detection of wave arrivals from weaker charges of explosives is detected reliably on accumulation records compared to no detection on ordinary records. The work done during 1959 to 1963 in Turkmenia in the northern part of the U.S.S.R., in the southern part of the Sea of Azov, and in the Caspian. L.S.

N65-21371# Atomic Energy Commission, New York, N. Y. Health and Safety Lab.
CARBON-14 MEASUREMENTS IN THE ATMOSPHERE, 1953 TO 1964
F. T. Hagemann, James Gray, Jr. (Argonne Natl. Lab.), and Lester Machta (Weather Bur.) 1 Apr. 1965 126 p refs
(HASL-159) CFSTI: $2.50

A C-14 sampling program has been conducted since 1953 using balloons and aircraft. Whole air collections have been obtained from ground level to greater than 100 000 ft. Over 3000 results of both the total and bomb-produced C-14 concentration in CO_2 are presented together with auxiliary δC-13 and CO_2 concentration determinations. It is expected that the findings subsequent to 1964 will be published periodically. A few C-14 in CO determinations are also given and interpreted. Author

N65-21374# Defence Research Board, Ottawa (Ontario).
ALOSYN: ALOUETTE I IONOSPHERIC DATA, 16 OCTOBER–31 OCTOBER 1962
[1962] 176 p

Selected ionospheric parameters obtained from Alouette I ionograms are listed in the order in which the ionograms are recorded, one tabulation row for each ionogram. The parameters are tabulated for all sounder data recorded during this period at the listed telemetry stations. L.S.

N65-21380*# Geophysics Corp. of America, Bedford, Mass.
RECENT CONTRIBUTIONS TO THE KNOWLEDGE OF ATMOSPHERIC STRUCTURE AND COMPOSITION OBTAINED FROM DIRECT PROBING EXPERIMENTS
H. E. La Gow and R. A. Minzner Feb. 1963 15 p refs
(Contract NASw-394)
(NASA-CR-57873; GCA-TR-63-7-n) CFSTI: HC $1.00/MF $0.50

The average atmospheric temperature and the mass density in the isothermal region above 200 to 300 km are both lower than corresponding values observed during the IGY, and both properties have significant short-term temporal variations. The 70- to 100-kilometer temperature profile through the mesopause was accurately measured for the first time. The base of the altitude region of atomic oxygen dominance (where atomic oxygen comprises 50% or more of the total atmosphere) was observed to be much lower than that generally assumed immediately after the IGY. Helium was recognized as being the dominant atmospheric constituent for a limited altitude region between the region of atomic oxygen dominance and the region of hydrogen dominance. Winds were measured synoptically up to 70-km altitude. A 1962 U.S. Standard Atmosphere to 700-km altitude was issued; it reflects the new temperature and density data but was prepared too soon to utilize the new O_2 dissociation information. Author

N65-21425*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science
THE MEASUREMENT OF THE SURFACE TEMPERATURE OF THE EARTH Technical Paper No. 64
William E. Marlatt Jan. 1965 14 p refs
(Contract NASr-147)
(NASA-CR-62117) CFSTI: HC $1.00/MF $0.50

The use of thermistors and infrared radiometers for surface temperature measurements of a sod-covered soil was investigated by comparison of data from 40 thermistors placed randomly over the surface of a field, simultaneous measurements of blackbody temperature of the surface at each thermistor location, and airborne radiometer observations. It was concluded that the surface temperature of a grass-covered earth can be measured as accurately with infrared radiometers as with miniature thermistors placed on the surface. The proper choice of a waveband filter makes it possible to conduct accurate satellite and aerial mapping of the earth surface temperatures. G.G.

N65-21434*# National Aeronautics and Space Administration, Washington, D. C.
METHOD OF CALCULATING LONGWAVE FLUXES IN THE TROPOSPHERE IN THE CASE OF A CLOUDLESS SKY [K METODIKE RASCHETA DLINNOVOLNOVYKH POTOKOV V TROPOSFERE PRI BEZOBLACHNOM NEBE]
Ye. P. Barashkova Apr. 1965 19 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 68–80
(NASA-TT-F-320) CFSTI: HC $1.00/MF $0.50

An investigation is made of the correlation of longwave fluxes computed from the Shekhter diagram for various levels in the troposphere with various meteorological elements. Simple equations are obtained for the descending flux

$$E_{Dz} = 0.76\sigma T_z^4 W_z^{0.12}$$

and the ascending flux

$$E_{Az} = \sigma T_s^4 \cdot 10^{-0.0036\Delta t},$$

where W_z is the absorbing mass above the level z, T_z is the air temperature at the level z, and T_s is the temperature of the base surface, $\Delta t = T_s - T_z$. The obtained equations are verified, and the average variation of E_{Dz} and E_{Az} as a function of altitude is presented for the cloudless sky at Odessa. Author

N65-21436*# National Aeronautics and Space Administration, Washington, D. C.
SPECTRAL REFLECTIVITY OF CLOUDS [SPEKTRAL'NAYA OTRAZHATEL'NAYA SPOSOBNOST' OBLAKOV]
Ye. P. Novosel'tsev Apr. 1965 10 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 186–191
(NASA-TT-F-328) CFSTI: HC $1.00/MF $0.50

The article considers the question of the spectral reflectivity of waterdrop clouds. It is shown that the clouds remain practically gray up to $\lambda \approx 0.7\mu$. In the absorption bands of water vapor, some decrease in reflectivity is observed. For $\lambda > 2.5\mu$, due to a large increase in the absorption of liquid water radiation, there is a sharp drop in the value of the cloud's albedo. A method is proposed for an approximate evaluation of the spectral albedo of ice clouds. Author

N65-21480*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CHEMICAL ASPECTS OF UPPER-ATMOSPHERE
[1963] 22 p refs
(NASA-TM-X-51723) CFSTI: HC $1.00/MF $0.50

The structure and composition of the atmosphere are reviewed, and the technique of measuring winds and other properties at night at altitudes greater than approximately 90 km is discussed in detail. The technique described complements the sodium vapor trail phenomena. Whereas the sodium method is based upon resonant scattering of the D-lines at twilight, this method uses a chemiluminescent gas trail. The energy for the chemiluminescent gas reaction is derived from the chemical energy stored in the upper atmosphere in the form of atomic oxygen. Tetramethyl-lead vapor trails in the lower atmosphere were found to be the most satisfactory of the various chemicals used for the chemiluminescent technique. These trails are shown in time sequences. The glow persisted for about 2 minutes before fading. Also, the atmospheric wind measurements resulting from the photographic observations of the tetramethyl lead vapor trails are given. E.E.B.

N65-21571# Joint Publications Research Service, Washington, D. C.
ALBEDO OF THE EARTH'S SURFACE WITHIN THE TERRITORY OF THE SOVIET UNION
V. V. Mukhenberg 19 Apr. 1965 23 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), 1963 p 43–60 (JPRS-29661; TT-65-30772) CFSTI: $1.00

This article dwells on methods of computing a mean albedo of a locality, on regularities in its distribution throughout the territory of the Soviet Union, and on peculiarities of its annual course in various climatic regions of the U.S.S.R. Author

N65-21611 Joint Publications Research Service, Washington, D. C.
SOLUTION OF STANDARD EQUATIONS FOR IONOSPHERIC LAYERS
G. I. Makarov *In its* Probl. of Wave Diffraction and Propagation 1965 p 3–26 refs (See N65-21610 11-07) CFSTI: $5.00

Description of radio wave propagation in ionized layers is developed through use of standard equation for simplification of the differential equation; asymptotic solution of the standard equation is presented. In the mathematical formulation of the problem, it is assumed that the ionization of the medium, which is characterized by the quantity of electrons in a unit volume and the number of collisions between electrons and ions in a unit time, is dependent only on one direction. An extensive appendix is included on the accuracy of asymptotic representations of the solutions of the standard equation. The results of this theoretical study are said to serve as a basis for study of fields in bounded and unbounded layers. J.M.D.

N65-21612 Joint Publications Research Service, Washington, D. C.
ASYMPTOTIC REPRESENTATIONS OF WHITTAKER FUNCTIONS
E. M. Gyunninen and G. I. Makarov *In its* Probl. of Wave Diffraction and Propagation 1965 p 27–71 refs (See N65-21610 11-07) CFSTI: $5.00

Asymptotic representations of Whittaker functions, which can be used in study of radio waves in ionized layers, are derived by the saddle point method and by the standard equation method. Under one specified set of conditions, it was found that the asymptotic representation has the form of functions of a parabolic cylinder, and that for quite general conditions the representation can be expressed by Bessel functions. The arbitrary values of the arguments and signs of the functions are discussed. Relief drawings of the Whittaker function modulus are shown for various parameter values. J.M.D.

N65-21617 Joint Publications Research Service, Washington, D. C.
POSSIBILITIES OF THE USE OF HIGH-FREQUENCY ELECTROMAGNETIC OSCILLATIONS IN EXPLORATION GEOPHYSICS
A. K. Bulgakov and V. M. Rysakov *In its* Probl. of Wave Diffraction and Propagation 1965 p 164–172 refs (See N65-21610 11-07) CFSTI: $5.00

Use of short radio pulses with broad spectrum for simplification of geophysical electrical exploration is described. The earth model consists of two parallel planes with specified thickness, conductance, and dielectric constants; the lower plane extends to infinity. Use of radio frequencies in obtaining information about the underlying surface, and of surface impedance in study of the upper surface, is discussed. Data are presented on the dependence of modulus of surface impedance and of attenuation function on frequency. In comparison with methods of radioscopy, direct measurement of surface impedance, or attenuation function, it was concluded that measurement of the reflection coefficient from the surface of the ground with normal incidence of a wave is the most promising method for geophysical explorations. J.M.D.

N65-21635*# Consultants and Designers, Inc., Arlington, Va.
INVESTIGATION OF THE LOWER IONOSPHERE BY THE IMPEDANCE LOW-FREQUENCY RADIOSONDE METHOD [ISSLEDOVANIYE NIZHNEY IONOSFERY METODOM IMPEDANSNOGO NIZKOCHASTOTNOGO RADIOZONDA]
P. E. Krasnushkin and N. L. Kolesnikov 16 Apr. 1965 24 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 55–69
(Contract NAS5-3760)
(NASA-TT-FF-9666; ST-AI-11317) CFSTI: HC $1.00/MF $0.50

A method of measurement of lower ionosphere parameters was worked out, consisting of the registration of input impedance of a miniature airborne antenna, sensitive to variations of electrical properties of the medium surrounding the antenna. This method was applied to measurement of electron concentration and the transport frequency of electron collisions with neutral molecules in the 50- to 90-km altitude range, using the 50-kc/sec frequency. The results agree well with those obtained by the methods of long and ultralong waves, of differential absorption, and also by that involving the use of high-frequency and Langmuir probes. The atmospheric pressure is measured in the 70- to 90-km altitude range by the transport collision frequency. It coincides with that of the standard atmosphere with a precision to 3% to 5%. Author

N65-21637*# Consultants and Designers, Inc., Arlington, Va.
ANALYSIS OF A FEW SONOGRAMS OBTAINED WITH THE AID OF SATELLITES ALOUETTE 1 AND INJUN 3 [ESSAI D'INTERPRETATION DE QUELQUES SONOGRAMMES OBTENUS A L'AIDE DES SATELLITES ALOUETTE 1 ET INJUN 3.-]
Roger Gendrin and Jacques Vigneron 19 Apr. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Groupe 10—Ionosphere, v. 260, 15 Mar. 1965 p 3129–3131
(Contract NAS5-3760)
(NASA-TT-F-9668; ST-AI-10319) CFSTI: HC $1.00/MF $0.50

This study refers to a new type of whistlers received on board satellites Alouette 1 and Injun 3. These can be interpreted as the result of propagation in the ordinary mode of the original atmospheric impulse, having recourse to certain hypotheses which are discussed. Author

N65-21649*# National Aeronautics and Space Administration, Washington, D. C.
THE DISTRIBUTION OF EFFECTIVE RADIATION THROUGHOUT THE USSR [RASPREDELENIYE EFFEKTIVNOGO IZLUCHENIYA PO TERRITORII SSSR]
L. N. D'Yachenko Apr. 1965 20 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 126–141
(NASA-TT-F-325) CFSTI: HC $1.00/MF $0.50

Charts of yearly and monthly distribution of effective radiation throughout the Soviet Union based on measurement data are presented. An analysis and comparison with analogous charts, composed from calculation data, are performed. Author

N65-21712# Space-General Corp., El Monte, Calif.
EFFECT OF SCATTERING BY PRECIPITATION ON APPARENT SKY TEMPERATURE IN THE MICROWAVE REGION
A. P. Stogryn 25 Sep. 1964 89 p refs
(SGC-613TM-1)

Calculations of the sky temperature with scattering included are formed by changing the basic equation of radiative transfer to a system of two coupled integral-differential equations together with appropriate boundary conditions that take the polarization effects of the ground emission properties into account. The basic transfer equations were found and are presented. Enumerations for several different summer conditions as well as a rain temperature of 10° C were studied and are shown in tabular form. Graphs present diffuse and specular surfaces. G.G.

N65-21721*# California Univ., La Jolla. Dept. of Earth Sciences
Rb-Sr AGES OF CHONDRULES AND CARBONACEOUS CHONDRITES
V. Rama Murthy and W. Compston (Australian Natl. Univ.) [1964] 33 p refs
(Grants NsG-323; NsG-701)
(NASA-CR-62201) CFSTI: HC $2.00/MF $0.50

Determinations of Rb, Sr and K and Sr isotopic compositions are reported for the carbonaceous chondrites Orgueil, Murray, Mokoia and Lance, the hypersthene chondrite Peace River, and four chondrules from the Peace River meteorite. The Rb and K show a decrease in abundance from Type I to Type III; Sr is relatively constant. An isochron constructed from the carbonaceous chondrite data alone has an age of 4.46 ±0.35 AE taking λ Rb^{87} equal to 1.39×10^{-11}/year, and an initial Sr^{87}/Sr^{86} of 0.7007. The age becomes 4.74 ±0.15 AE if the initial Sr^{87}/Sr^{86} is assumed to be 0.6985, but residual variance in the regression now becomes greater than experimental error. Most of the residual variance is contributed by the Type III carbonaceous chondrites. Inclusion of the data for the Peace River chondrite changes the age only slightly to 4.76 AE. Author

N65-21748# Stanford Univ., Calif. Stanford Electronics Labs.
A COOPERATIVE REPORT ON THE CORRELATION BETWEEN AURORAL, MAGNETIC, AND ELF PHENOMENA AT BYRD STATION, ANTARCTICA
Ward J. Helms and John P. Turtle (Arctic Inst. of North Am.) Aug. 1964 42 p refs
(Grant NSF G-17217)
(SEL-64-043; TR-3408-2)

The results of a synoptic correlation study carried out at Byrd Station, Antarctica, during the austral winter of 1962 are given. The data cover the months of June, July, and August. Several independent data systems were used to continuously monitor the electromagnetic spectrum from 0.05 cps through 20 kc. Quantitative amplitude vs frequency records of the upper elf and vlf bands are shown. Synoptic auroral data were obtained from an all-sky camera, all-sky photometer, and narrowbeam photometer. Some regular slow-speed magnetograph data are also shown. The geophysical events recorded are seen to fall into two broad categories: the impulsive events near magnetic midnight, and the regular events near magnetic noon. Detailed relationships between phenomena during typical events of both types are shown. The magnetic-midnight events are seen to be very large amplitude, short-lived disturbances characterized by correlated auroral flareups, vlf hiss burst, and rapid magnetic-field variations. The magnetic-noon disturbances are of lesser intensity and longer duration, and are characterized by vlf chorus and regular-type magnetic micropulsations. No correlation between these phenomena is evident except for agreement between minute intensity pulsations in the aurora and magnetic micropulsations in the period preceding magnetic noon. No correlation was found between elf signals and other geophysical events at any time of day. Author

N65-21928# Emmanuel Coll., Boston, Mass. Research Language Center
PROBLEMS OF PHYSICAL TECTONICS. ELASTIC STRESSES AND FRICTION STRESSES [PROBLEME DER PHYSIKALISCHEN TEKTONIK. ELASTISCHE SPANNUNGEN UND REIBUNGSSPANNUNGEN]
Rolf Hoeppener Bedford, Mass., AFCRL, Aug. 1964 45 p refs Transl. into ENGLISH from Z. Deut. Geol. Ges. (Berlin), v. 114, pt. I, 1962 p 206–227
(Contract AF 19(628)-3869)
(E-T-G-64-39; AD-456873)

The possibilities of setting up experiments in tectonic research are investigated. A theory of the reactions and forces inside a body during permanent deformation is developed and discussed. Author

N65-21963# California Univ., Livermore. Lawrence Radiation Lab.
GAMMA DOSE RATES AND INTEGRATED DOSES FROM NEUTRON-INDUCED RESIDUAL RADIOACTIVITY IN SOIL, VOLUME II
R. M. Lessler and F. W. Guy 1 Mar. 1965 294 p
(Contract W-7405-ENG-48)
(UCRL-12339, Vol. II)

Computer printouts of tables of data for gamma dose rates and integrated doses from neutron-induced residual radioactivity in soil are given. Individual tables are: soil constituents and neutron reactions; fluxes in the soil; the total dose from time zero to 50 years from each soil element; adjusted to represent 100% soil abundance of the particular element; the dose rate at time zero for each soil element, representing 100% abundance of the element; actual dose rate by time and distance; and total doses integrated from a given time to 50 years. The use of these tables is described in volume I, which should be read before using these tables. L.S.

N65-21974* Stanford Univ., Calif. Radioscience Lab.
DAYTIME WHISTLER-MODE ATTENUATION THROUGH THE LOWER IONOSPHERE AT 15.5 Kc AS MEASURED ON EXPLORER VI DURING LAUNCH TRAJECTORY
R. F. Mlodnosky, R. A. Helliwell, and L. H. Rorden (Stanford Res. Inst.) *In* NASA. Washington Sci. Findings from Explorer VI 1965 p 91–100 refs (See N65-21965 11-29)
GPO: HC $2.25; CFSTI: MF $2.00

Signals from the U.S. Navy Station NSS (15.5 kc) were detected over the altitude range of zero to about 160 km by a satelliteborne vlf receiver during the daytime launch phase of the Explorer VI Satellite. The signals were received on a small electric antenna which was also used simultaneously to transmit vhf telemetry. During the launch phase, the antenna was confined between the third-stage rocket case and the folded solar paddles, with an epoxy shroud covering the satellite and the third-stage rocket. Nevertheless, signals were clearly visible in amplitude-time chart recordings (50-cps bandwidth) up to 67-km altitude. The signal variations between 67 km and 160 km were obtained by narrowband cross-correlating filter techniques. The receiver output was interpreted in terms of incident electric field strength, and the total measured attenuation through the lower ionosphere up to 150 km was estimated to be 43 dB. A predicted total attenuation was computed, including the effects of absorption, the change in antenna impedance within the ionosphere, reflection losses, and antenna polarization. The predicted and measured attenuations are in good agreement. Author

N65-22004# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
ANALYSIS TECHNIQUES FOR DETERMINING MASS MOTIONS IN THE UPPER ATMOSPHERE FROM CHEMICAL RELEASES Scientific Report No. 1
C. G. Justus, H. D. Edwards, and R. N. Fuller Jan. 1964 40 p refs
(Contract NAS1-1671; Grant NsG-304-63; Contracts AF 19(628)-393; AF 19(628)-3305; ARPA Order 42)
(AFCRL-64-187; AD-435678)

Analysis procedures are presented for determining mass motions in the upper atmosphere by photographic triangulation and tracking of artificial clouds produced by chemical releases. Techniques are given both for clouds with identifiable features which can be tracked and for trail clouds with few or no identifiable features. A discussion of various coordinate systems necessary for both the determination of camera orientation and the triangulation calculations is also included. All of these coordinate systems are suitable for the assumed earth—an ellipsoid of revolution. Author

N65-22007# Army Materiel Command, Hanover, N. H. Cold Regions Research and Engineering Lab.
A STUDY OF ICE FOG AND ICE-FOG NUCLEI AT FAIRBANKS, ALASKA, PART II
Motoi Kumai and Harold W. O'Brien Apr. 1965 19 p refs
(CRREL-RR-150; AD-451667)

The investigation encompassed (1) meteorological study of conditions favoring occurrence and persistence of ice fog; (2) observations of ice-crystal formation with water vapor and ice-forming nuclei provided by combustion products from a power plant chimney and automobile exhaust; (3) design of a cascade impactor for use with a tethered blimp; (4) studies of size relationship between ice-fog crystals and their nuclei; and (5) comparison of size distributions between some seeding agents and natural ice-fog crystals, and their nuclei. From 1957 to 1963, the longest continuous ice fog was 186 hr in Dec 1961, while 60% of all ice fogs were of less than 6-hr, and 80% of less than 24-hr duration. The measured mean diameters of ice-fog nuclei ranged from 0.1μ to 1.2μ for ice crystals of 5μ to 22μ mean diameter, with no apparent size relationship between a given crystal and its nucleus. Ice from exhaust vapors can be observed at −20 C but, in general, the concentration of crystals formed at these temperatures is low. Dense ice fog persisted only at −40 C or lower, and only over populated areas where products of hydrocarbon combustion provide sufficient water vapor and nucleating material. Author

N65-22033# Norwegian Defence Research Establishment, Kjeller.
A STUDY OF IONOSPHERIC IRREGULARITIES Final Scientific Report
P. Christophersen 23 Oct. 1964 127 p refs
(Contract AF 61(052)-500)
(AFCRL-65-56; AD-610861)

Electromagnetic waves reflected from a random medium are described in terms of spatial correlation and of correlation between signals reflected at adjacent frequencies. The propagation of these correlation functions is studied both for limited and unlimited reflectors. Several different reflector models which could give rise to the random properties of the reflected waves are then discussed and various parameters are related to the observable correlation functions. Author

N65-22034# Northwestern Univ., Evanston, Ill.
WHIRLPOOL, A COMPUTER PROGRAM FOR "SORTING OUT" INDEPENDENT VARIABLES BY SEQUENTIAL MULTIPLE LINEAR REGRESSION
W. C. Krumbein, Betty T. Benson, and W. B. Hempkins 1964 53 p refs
(Contract Nonr-1228(26))
(TR-14; AD-611142)

The problem of identifying those variables in some larger set that exert most control on a given dependent variable is encountered in many earth-science problems. A variety of methods is available for ranking independent variables in the order of their importance, and the procedure described here is based on a straightforward least-squares use of the general linear model. The method consists in taking the independent variables one at a time, two at a time, and so on, until all possible combinations are included. Thus, no assumptions are made about the significance of any variable or combination of variables: the full output is presented to facilitate substantive evaluation. The program is designed as a data-search procedure, although it can be modified to include F tests and similar aspects of more formal statistical analysis if desired. This report describes the mathematical procedures involved, it illustrates the method with a geological example, and it includes instructions for program operation. A Fortran II listing of the program is given. Author

N65-22045# Michigan Univ., Ann Arbor. VELA Seismic Information Analysis Center
YELLOWKNIFE SEISMOGRAMS FOR SMALL MAGNITUDE EVENTS
15 Feb. 1965 42 p

Twenty British seismograms obtained at Yellowknife of small magnitude events are presented as one of the basic sets of data indicating that small-magnitude earthquakes remain complex in nature. E.E.B.

N65-22085# Emmanuel Coll., Boston, Mass. Research Language Center
A GEOPHYSICAL INTERPRETATION OF THE DATA ON THE NEWEST AND RECENT PLUTONIC TECTONIC MOVEMENTS [GEOFIZICHESKAIA INTERPRETATSIIA DANNYKH O NOVEISKIKH I SOVREMENNYKH GLUBINNYKH TEKTONICHESKIKH DVIZHENIIAKH]
M. V. Gzovskii Bedford, Mass., AFCRL, Jul. 1964 66 p refs Transl. into ENGLISH from Rezul'taty Issled. po Uezhdunarodnym Geofiz. Proektam (USSR), no. 1, 1963 p 37–63
(Contract AF 19(628)-3869)
(E-T-R-64-33; AD-611123)

Data relating to the phenomena of the recent and newest tectonic movements on the upper surface of the earth's crust can be used to explain the important features of the subsurface geological and geophysical processes which at the present time are developing within the earth's crust and in the upper portion of the subcrustal mantle (in the upper mantle). The vertical velocity component of tectonic movements gives a basis for objectively relating the recent and newest movements of each region to one of the genetic types when one compares the sign of this component with data from subsurface seismic soundings and with the sign of the true isostatic gravity anomaly. The movements directed towards an isostatically equilibrated position of the earth's crust are principally different in origin from the movements by which the earth's crust is removed from an isostatically equilibrated position. Further separation and explanation of the movements would be hypothetical at the present time. A comparison of the values of the vertical and horizontal velocity components of the recent and newest movements will make it possible to make a selection more valid than the present one between the two main current hypotheses about the physical nature of the subsurface processes occurring within the earth's crust and in the subcrustal mantle. TAB

N65-22104# Naval Research Lab., Washington, D. C. Surface Chemistry Branch
ADSORPTION OF SURFACE-ACTIVE MATERIAL AT THE SEA/AIR INTERFACE Interim Report
N. L. Jarvis 8 Feb. 1965 15 p refs
(NRL-6220; AD-612095)

The concentration of soluble, surface-active, organic matter in the ocean will vary with time and location. In general, sufficient surface-active material will be present to provide closely packed films at the surface under favorable conditions. The rates of adsorption of the surface-active material at a sea/air interface were studied by measuring surface tension and surface potential as a function of time. The sea water samples studied were from the ocean near La Jolla, California. Surface potential measurements indicated that adsorption of surface-active material began immediately after the interface was cleaned; however, a noticeable decrease in surface tension was not observed until the water surface was covered with a continuous film of surface-active material. Between 10 and 60 minutes were usually required to give a film having a film pressure of a few tenths of a dyn/cm, the minimum film pressure normally associated with the damping of capillary waves. Changes in surface potential and surface tension were also determined as functions of the degree of compression of the adsorbed material. Author

N65-22151# Oregon State Univ., Corvallis.
THEORETICAL AND FIELD STUDIES OF SEISMIC WAVES Final Research Report, 1 Apr. 1962–1 Apr. 1964
Joseph W. Berg, Jr. [1964] 6 p refs
(Grant AF-AFOSR-62-376; ARPA Order 292-62)
(AD-612033)

The objective of the research was to determine a method for evaluating the size of a seismic source using amplitudes and/or energy content of the seismic waves generated by the source. Each distance range (local, near-regional, regional, and teleseismic) was considered separately to divide the major problem into several smaller ones. Only the initial seismic disturbance was considered for this work. Data recorded from Gnome, Hardhat, Haymaker, and Shoal nuclear explosions were chosen to represent the seismic sources for this work. The research that was done for seismic waves recorded in the various distance ranges will be discussed. In general, the continuity of energy of the seismic waves recorded from the above explosions was sought for the entire range of distances over which the seismic waves were recorded. TAB

N65-22185*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC CONTROL OF DIFFUSION IN THE UPPER ATMOSPHERE
S. Chandra and R. A. Goldberg Apr. 1964 37 p refs
(NASA-TM-X-51704) CFSTI: HC $2.00/MF $0.50

The derivation of the commonly employed diffusion equation was shown to be based on assumptions concerning the equations of motion which are inconsistent with the observed distribution unless an additional constraint equation is applied. However, the application of the restraint equation also gives incorrect results. Therefore, it was concluded that the currently used forms of the diffusion equation which take geomagnetic control into account do not provide correct results because they are based on improper models for the ionosphere. Further, it was found that although field alined diffusion equilibrium provides the correct form, a more reasonable assumption concerning electron and ion collisions with neutrals leads to the same result. By combining the equations of motion for neutrals, electrons, and ions, it was possible to predict geomagnetic control for the neutral atmosphere in the lower F region of the ionosphere, although the exact shape of this distribution is unknown. E.E.B.

N65-22197*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN EVALUATION OF THE MAIN GEOMAGNETIC FIELD, 1940–1962
Joseph C. Cain, W. E. Daniels, Shirley J. Hendricks, and Duane C. Jensen (Dikewood Corp.) Dec. 1964 70 p refs Presented at the Symp. on Magnetism of the Earth's Interior, Pittsburgh, 16 Nov. 1964 Submitted for Publication
(NASA-TM-X-55201; X-612-65-72) CFSTI: HC $3.00/MF $0.75

A new determination is made of the geomagnetic field and its secular change using a set of 21 695 selected survey and observatory annual mean data available for the interval 1940 to 1963. The field is given by a series of 63 spherical harmonics (g_n^m and h_n^m to $n=m=7$) and 35 time derivatives ($\dot{g}_n^m$ and $\dot{h}_n^m$ to $n=m=5$). The standard errors and confidence levels are given for the coefficients to show that almost all are well determined. The rms deviations of this fit from several selections of survey data are used in comparison with similar results from other coefficient sets to show that this set of coefficients is considerably more accurate than any published previously. Author

N65-22200*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE STABILITY OF THE BOUNDARY OF THE GEOMAGNETIC FIELD

John R. Spreiter and Audrey L. Summers [1964] 32 p refs Submitted for Publication
(NASA-TR-R-206) CFSTI: HC $2.00/MF $0.50

The response of the magnetosphere boundary in a steady solar wind to small initial departures from equilibrium is investigated in accordance with the classical model of Chapman and Ferraro. If the wavelength and amplitude are sufficiently small that curvature and second-order effects can be disregarded, all perturbations, except those having wave fronts alined with the direction of the local magnetic field, are found to damp exponentially with time and to drift along the boundary with the tangential component of the solar wind. Alined waves, which neither damp nor amplify in this approximation, are examined further by inclusion of curvature and higher order effects. A first-order analysis shows that curvature introduces a destabilizing effect in small regions in the vicinity of the neutral points and a stabilizing effect elsewhere. Possible geophysical consequences are discussed. An exact solution for an alined cylindrical solitary wave having an initial form of a circular arc is also presented. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-21256# Joint Publications Research Service, Washington, D. C.
EXPERIENCE IN USE OF A FREQUENCY SELECTION CHANNEL IN AN AIRBORNE MAGNETOMETER
L. V. Vavilin and D. S. Zelenetskiy 12 Apr. 1965 9 p Transl. into ENGLISH from Razvedka i Okhrana Nedr (Moscow), no. 2, Feb. 1965 p 25–29
(JPRS-29525; TT-65-30703) CFSTI: $1.00

A frequency-selection channel in an airborne magnetometer and its use during detailed geological mapping for detection of local magnetic anomalies are described. The proposed frequency-selection channel is a three-stage filter amplifier using a push-pull system which insures amplification of signals in a narrow band of low frequencies. A graphic example is given on the use of data from a frequency-selection magnetic channel in geological mapping. Comparison of data from ground magnetic survey with air measurements is presented. It was concluded that it is feasible to use the principle of frequency selection in airborne magnetometers for the detection of relatively weak signals from thin objects on the background of quiet magnetic fields. J.M.D.

N65-21280# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
CONTINUOUS CURRENT LOGARITHMIC TRANSDUCER [TRASDUCTOR LOGARITMICO DE CORRIENTE CONTINUA]
Abel Julio Gonzalez 1964 8 p refs In SPANISH
(Rept.-131)

A logarithmic transducer with a voltage output that could be varied over a range of 20 volts was needed for equipment to determine the radiation received by film monitors. A very simple and low-cost transducer was developed. The transducer consists of one double triode tube and five resistors, a regulatable voltage source with an output of 25 to 12 volts, and a voltage amplifier. The voltage response of the transducer can be easily varied by replacing the triode with one of different frequency response. The mathematical formula and circuit diagram are given. Transl. by F.E.R.

N65-21323*# Moog Servocontrols, Inc., East Aurora, N. Y.
QUALIFICATION TEST REPORT FOR MOOG MODEL 17-150D SERVOACTUATOR AND MOOG MODEL 16-120A SERVOVALVE, VOLUME IV Potentiometer Test Report Supplement
A. D. Storms and R. L. Black 24 Sep. 1964 51 p
(Contract NAS8-2674)
(NASA-CR-57973; MR-838, Rev. A) CFSTI: HC $3.00/MF $0.50

Performance and environmental tests were made on the Markite Model 9044 potentiometer, a redesigned version of the Model 8520 potentiometer. The performance characteristics of the basic potentiometer were satisfactory throughout the supplementary test program except for the minor discrepancy in contact resistance noise. The results of the test program indicate that the potentiometer design has been improved to a sufficient extent to satisfy qualification test requirements for the Markite Model 9044 which will be employed in servoactuators. L.S.

N65-21328*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Electronics Lab.
DESIGN STUDY OF A CLOUD PATTERN RECOGNITION SYSTEM Quarterly Progress Report, 15 Jun.–15 Sep. 1964
[1964] 58 p
(Contract NAS5-3866)
(NASA-CR-57948; SM-46215-Q1) CFSTI: HC $3.00/MF $0.50

The iterative design-discriminant analysis learning algorithm is being applied, by means of a computer simulation using an IBM 7094, to the specification of a parallel logic structure required for the automatic recognition of vortices in TIROS cloud cover photographs. The effects of gray scale and noise in the input patterns are being investigated on sample problems using alphabetic characters. Other system design parameters are being investigated using both the cloud cover photographs and the sample problem data. The gray scale investigation resulted in the development of design routines that are invariant under linear gray scale transformations. Routines for formatting the digitized cloud patterns for input to the 7094 were developed, as were techniques for printing out the test data to validate the records. Computer programs were prepared for design of character recognition systems using the iterative design-discriminant analysis learning algorithm. Some results were obtained on the effect of variation of system parameters on system performance. The main computer program to examine the actual TIROS data is being validated. All TIROS data (vortex and nonvortex patterns) were selected and verified, and the digitized tapes are on order. Author

N65-21329*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Electronics Lab.
DESIGN STUDY OF A CLOUD PATTERN RECOGNITION SYSTEM Quarterly Progress Report, 15 Sep.–15 Dec. 1964
[1964] 52 p
(Contract NAS5-3866)
(NASA-CR-57949; SM-46215-Q2) CFSTI: HC $3.00/MF $0.50

The iterative design-discriminant analysis learning algorithm is being applied, by means of a computer simulation using an

IBM 7094, to the specification of a parallel logic structure required for the automatic recognition of vortexes in Tiros cloud cover photographs. The effects of gray scale and noise in the input patterns are being investigated on sample problems using alphabetic characters. Other system design parameters are being investigated using both the cloud cover photographs and the sample problem data. The gray scale investigation has resulted in the development of design routines that are invariant under linear gray scale transformations. Routines for formatting the digitized cloud patterns for input to the 7094 have been developed, as have techniques for printing out the test data to validate the records. Computer programs have been prepared for design of character recognition systems using the iterative design–discriminant analysis learning algorithm. Some results were obtained on the effect of variation of system parameters on system performance. Author

N65-21335*# Georgia Univ., Athens. Physics Dept.
SPECTROGRAPHIC COVERAGE AND DATA REDUCTION OF NASA CHEMICAL RELEASE. STUDIES DIRECTED TOWARD DESIGN AND DEVELOPMENT OF NEW SPECTROGRAPHIC INSTRUMENTATION Final Report
C. Dewey Cooper 30 Jun. 1964 7 p
(Contract NAS1-1672)
(NASA-CR-57901) CFSTI: HC $1.00/MF $0.50

A slitless spectrograph was designed and constructed using an 1800 groove/mm reflection grating and an F/0.87 camera lens of 76-mm focal length to provide a dispersion of 70 Å/mm. This instrument gave excellent spectra for upper atmosphere chemical releases during the Firefly III series. Author

N65-21336*# Optics Technology, Inc., Belmont, Calif.
FIBER OPTICS SYSTEMS FOR PLANETARY SCAN SYSTEM Final Technical Report
D. F. Capellaro Jan. 1965 38 p Prepared for JPL
(Contracts NAS7-100; JPL-950586)
(NASA-CR-57977) CFSTI: HC $2.00/MF $0.50

Design of a lightweight optical sighting and tracking system, incorporating a fiber optics cone, is presented for use in the Mariner B spacecraft. The system is shielded by an outer cylinder to preserve vibrational and thermal equilibrium. Problems overcome in fabricating the field lens, cone housings, detector, and detector mounting, are described. It was found that a forming process in which the entire cone was fabricated under continuously drawn vacuum would lead to high-quality cones. Transmission measurements of the components are shown; it was concluded that the transmission range for the overall system meets most specifications. J.M.D.

N65-21337*# Philips Electronics and Pharmaceutical Industries Corp., Mount Vernon, N. Y. Philips Electronic Instruments
LUNAR X-RAY DIFFRACTOMETER Final Report
Jul. 1964 143 p Prepared for JPL
(Contracts NAS7-100; JPL-950158)
(NASA-CR-57976; PEI-4-D64-0230) CFSTI: HC $4.00/MF $1.00

This report documents the development of X-ray diffractometers designed to be prototypes for the Surveyor lunar landing vehicle. By the technique of X-ray diffraction, these instruments were designed to analyze the mineralogical compositions of lunar materials. This information, when telemetered to the ground, will enable diffraction patterns of lunar samples to be reconstructed and analyzed on the earth. The evolution of the design, development, fabrication, and test of five prototype diffractometer models is presented. Author

N65-21365* Joint Publications Research Service, Washington, D. C.
MEASUREMENT EQUIPMENT AND METHODS FOR ROCKET TESTING
A. V. Kantor 15 Apr. 1965 308 p refs Transl. into ENGLISH from the book "Apparatura i Metody Izmereniy pri Ispytaniyakh Raket" Moscow, Oborongiz, 1963 p 2–517
(JPRS-29603; TT-65-30743) CFSTI: $7.00

This book presents the methods and systems of measurement used in the captive and flight tests of rockets. Detailed descriptions are given of the radio telemetry and onboard measurements, trajectory measurements, the methods of combining the telemetry and trajectory measurements, the time correlation systems, and various forms of static tests. Consideration is given to the measurements themselves and also to the processing of the results obtained. Along with the analog-type systems, a detailed consideration is given of the digital systems for measuring results and for the automation of the processing of the measurement results from both test stand and flight tests. Various types of equipment used in rocket test measurements are also described. Author

N65-21435*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION OF CERTAIN ERRORS OF BOLOMETRIC PYRHELIOMETERS [RASCHET NEKOTORYKH OSHIBOK BOLOMETRICHESKOGO PIRGELIOMETRA]
Yu. A. Sklyarov Apr. 1965 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 52, 1964 p 81–89
(NASA-TT-F-321) CFSTI: HC $1.00/MF $0.50

The following are computed for a single-layer pyrheliometer with a sensor consisting of a wire spiral: the effect of heat transfer through the wires which serve as supports and current conductors, and the difference in the position of heat sources during the illumination and during the heating produced by the current. The nonconductive parts of the spiral consisting of cement and a black coating are taken into account. Author

N65-21460*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DESIGN OF THE RANGER TELEVISION SYSTEM TO OBTAIN HIGH-RESOLUTION PHOTOGRAPHS OF THE LUNAR SURFACE
Donald H. Kindt and Joseph R. Staniszewski 1 Mar. 1965 29 p refs
(Contract NAS7-100)
(NASA-CR-62189; JPL-TR-32-717) CFSTI: HC $2.00/MF $0.50

The design of the television system incorporated into the Ranger spacecraft, which obtained the first high-resolution closeup photographs of the lunar surface on July 31, 1964, is described. The entire system design is presented, including both the ground recovery system and the flight system. The 380-lb flight system includes six cameras, sequencers, command-control circuitry, two transmitters, telemetry system, batteries, power supplies, and thermal control surfaces. Emphasis is given to the design of the cameras, the sequencing and logic required for the various commands, and the transmitter configuration. Such characteristics as camera parameters (sensitivity, line density, spectral response, resolution), the programing of the camera readouts to utilize the available transmitter bandwidth, and the transmission of the outputs of the two transmitters simultaneously over one high-gain antenna are presented. A brief description is given of the mission flight sequence, along with some of the constraints and unknown factors that influenced the design of the television system. The design of the ground recovery system is presented. Author

N65-21464*# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.

INSTRUMENTATION DESIGN STUDY FOR TESTING A HYPERSONIC RAMJET ENGINE ON THE X-15 A-2. VOLUME 2: PRELIMINARY DESIGN OF IN-FLIGHT THRUST/DRAG MEASURING DEVICE

D. J. DeMichele, R. L. George, R. M. Mains, and N. H. Wood Mar. 1965 190 p refs

(Contract NAS4-715)

(NASA-CR-62183) CFSTI: HC $5.00/MF $1.25

Results of a preliminary design study for a thrust–drag device to measure net ramjet nacelle thrust or drag transmitted to the X-15 A-2 aircraft are presented. The results indicate that (1) such a device can be built; (2) the ramjet should be suspended from the X-15 from two widely spaced points of attachment; (3) one of the attachments should be rigidly attached to the ramjet, the other should be flexible in the fore and aft direction; (4) the thrust and drag forces of the ramjet will produce deflections in deflection block sensors at both points of support that can be detected by linear variable differential transformers; (5) rollers are recommended for the flexible point of support; (6) construction of a full-size model is recommended; (7) the calculation methods are appropriate for other than the reference size (188-in.) ramjet; and (8) development of the thrust–drag device as a four-phase program can be completed by mid-1967. M.P.G.

N65-21465*# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.

INSTRUMENTATION DESIGN STUDY FOR TESTING A HYPERSONIC RAMJET ENGINE ON THE X-15 A-2. VOLUME 3: CONCEPTUAL DESIGN OF MEASUREMENT SYSTEMS

J. E. Fischer, W. M. Shaffernocker, C. M. Stanforth, and J. F. Williams 20 Mar. 1965 182 p refs

(Contract NAS4-715)

(NASA-CR-62148) CFSTI: HC $5.00/MF $1.25

The instrumentation requirements study for an experimental hypersonic ramjet engine to be flight tested on the X-15 A-2 airplane has been completed. The major results are (1) the preliminary design of a direct thrust–drag measurement system for the experimental ramjet, a preliminary thermal and mechanical performance analysis, and identification of development programs leading to an in-flight measurement; (2) development of a conceptual design of instrumentation systems and techniques for performing desired measurements during flight testing; and (3) a proposed overall program for development, cost, and lead times of the important instrumentation systems. Specific program conclusions and recommendations are also presented. G.G.

N65-21466*# Aracon Geophysics Co., Concord, Mass.

APPROACHES TO ON-BOARD GRIDDING OF APT PICTURES, PHASE 1 Quarterly Report No. 1 (Final)

Robert P. Bartlett, ed. 15 Jan. 1965 210 p *Its* Rept.-9G9-11

(Contract NAS5-9012)

(NASA-CR-62182) CFSTI: HC $6.00/MF $1.25

This report discusses various methods by which the latitude–longitude grid can be added to the video picture onboard the satellite. Both analog and digital approaches to onboard gridding were considered; several digital approaches were found feasible. These approaches call for computer computation of the picture grids on the ground, transmission of the grid line data to the satellite for storage, and logic circuitry to withdraw the data from memory and electronically mix grid line marks into the video during the picture scan. The approaches judged feasible are these: (1) straight line method where the curved grid lines are approximated with straight line segments whose slope, length and initial coordinates are transmitted to the satellite, (2) coordinate method where the individual image plane coordinates of each mark are transmitted, (3) slope–coordinate method where starting coordinates and a slope range are specified to reduce the information necessary to obtain the image plane coordinates of each mark. The flight system weight and power requirement is approximately 7 to 8 pounds and less than 2 W, respectively. Author

N65-21471*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A VARIABLE EXPOSURE PHOTOGRAPHIC PYROMETER

Reginald J. Exton [1964] 13 p refs Presented at the 19th Ann. ISA Conf. and Exhibit, New York, 12–15 Oct. 1964

(NASA-TM-X-51702) CFSTI: HC $1.00/MF $0.50

The instrument described is a device which attenuates by known amounts the light intensity received from a radiating source by use of a variable-density filter. The attenuated beams are photographed, and the resultant film densities, coupled with their associated filter values, yield a time-history of the temperature contour. The blackbody temperature range is 1800° to 3600° F with a precision of approximately 2% for most applications. Author

N65-21513# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF AUTOMATICALLY MEASURING SMALL DEVIATIONS IN PITCH OF DETAILS WITH PERIODIC STRUCTURES

V. N. Zabolotskiy 17 Jun. 1963 4 p Transl. into ENGLISH from Russian Patent no. 145011 (Appl. no. 696354/25), 6 Feb. 1961 p 1–2

(FTD-TT-63-500/1+2; AD-413579)

A method for automatic measurements of rapid pitch deviations is described; it compares the constant magnitude of one light beam proportional to the mean pitch of the investigated subject, with the value of an another light beam that changes in conformity with the pitch of the investigated object. This method of deviation measurement increases the reliability of the measured results. G.G.

N65-21519# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MEASURABILITY AND LEGIBILITY OF AERIAL PHOTOGRAPHS

L. Molnar 19 Mar. 1965 48 p refs Transl. into ENGLISH from Geodizia es Kartografia (Budapest), no. 2, 1963 p 24–38

(FTD-TT-64-918/1+2+3+4; AD-460495)

Resolving power and selectivity, design and testing of lenses, translational and rotational components of aerial camera vibration, image migration, film development and quality control techniques used in photographic processing, geometrical precision of parallax measurement, and color and contrast of the terrain are discussed with respect to their importance to the measurability and legibility of aerial photographs for large and small scale cartography. S.C.W.

N65-21630*# National Aeronautics and Space Administration, Washington, D. C.

EXPERIENCE GAINED IN USE OF AN ELECTROSTATIC ANALYZER ON BOARD THE "KOSMOS-12" SATELLITE [OPYT PRIMENENIYA ELEKTROSTATICHESKOGO ANALIZATORA NA SPUTNIKE "KOCMOC-12"]

V. V. Mel'nikov, I. A. Savenko, B. I. Savin, and P. I. Shavrin Apr. 1965 13 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 148–154
(NASA-TT-F-9319) CFSTI: HC $1.00/MF $0.50

The article describes the design of a spherical electrostatic analyzer, used for investigating fluxes of electrons and positive ions with an energy E = 1 KeV during the flights of the Kosmos-12 and Kosmos-15 satellites. The operating characteristics of the analyzer were as follows: transmission bandwidth $\Delta E/E \sim 30\%$ and sensitivity threshold (assuming flux isotropy) $\sim 6 \times 10^6$ particles/cm^2 sec KeV. The results of measurements during the flight of Kosmos-12 are presented. The constantly present electron and ion fluxes with E = 1 KeV on the night side of earth usually do not exceed the sensitivity threshold of the instrument. South of New Zealand, instances of increase in the intensity of electrons with E = 0.5 to 1 KeV have been observed. The appearance of electrons and ions with E = 1 KeV over the Pacific has been recorded. Author

N65-21650*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PORTABLE PFM SIMULATOR
Harold Levy, Paul Heffner, and Joseph Tinsley Sep. 1964 40 p (NASA-TM-X-55179; X-544-64-394) CFSTI: HC $2.00/MF $0.50

The pulse-frequency modulation simulator, a synchronous 16-channel frame pulse-frequency modulated signal simulation unit, is described. Burst width, burst frequency, and burst amplitude are available by front panel control. The frame-synchronization burst can be positioned where desired at the beginning of the frame. The unit covers the data burst-rate range of 20 to 250 bursts/sec and is continuously variable over these limits in just two ranges. The frequency within the data burst may be internally or externally applied; noise may be linearly summed with the signal by applying a noise generator signal to the unit. The unit, which is fully transistorized, employs functional printed-circuit modules, including the power-supply regulator. The specifications, operating instructions, description and theory of operation, circuits, and performance checks are included. E.E.B.

N65-21675 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
ELECTRO OPTICS
H. J. Woll 1964 68 p refs

CONTENTS:

1. ELECTRO-OPTICAL ENGINEERING AT BURLINGTON P. E. Seeley p 2–6 refs
2. AN/FSR-2–AN ADVANCED SYSTEM FOR PHOTO-ELECTRONIC DETECTION AND PLOTTING BEYOND RADAR RANGES C. B. Park p 7–9 refs (See N65-21676 11-14)
3. PASSIVE INFRARED TRACKING EQUIPMENT J. H. Woodward p 10–15 ref (See N65-21677 11-14)
4. INFRARED FIBER OPTICS N. Aron and L. Arlan p 16–19 refs (See N65-21678 11-14)
5. SOME RECENT DEVELOPMENTS IN HIGH-SENSITIVITY COOLED-FILTER INFRARED DETECTORS H. Pullan p 20–22 refs (See N65-21679 11-14)
6. ELECTRO-OPTICAL SIGNAL PROCESSING M. J. Cantella and R. C. Kee p 23–27 ref (See N65-21680 11-14)
7. GENERATION OF OPTICAL HARMONICS H. J. Okoomian p 28–31 refs (See N65-21681 11-26)
8. RECENT DEVELOPMENTS IN PHOTO-TAPE CAMERAS W. J. Poch p 33–36 refs (See N65-21682 11-14)
9. VIDICON APPLICATIONS FOR SPACE-BORNE TV CAMERAS M. H. Mesner p 37–41 refs (See N65-21683 11-14)
10. RANGER TV SUBSYSTEM B. P. Miller p 42–45 (See N65-21684 11-14)
11. TELEVISION FOR STELLAR ORIENTATION OF THE ORBITING ASTRONOMICAL OBSERVATORY W. Sensenig and M. Kravitz p 46–48 (See N65-21685 11-14)
12. DEVELOPMENTS IN ELECTRON OPTICS PRODUCE TWO NEW LINES OF VIDICON TUBES R. G. Neuhauser p 49–51 refs (See N65-21686 11-09)
13. ULTRA-PORTABLE TELEVISION CAMERA SYSTEM J. Castleberry p 52–55 refs (See N65-21687 11-14)
14. PHOTOCOMPOSITION MACHINE FOR THE CHINESE LANGUAGE F. E. Shashoua p 56–59 (See N65-21688 11-08)
15. ENGINEERING AND RESEARCH NOTES. BRIEF TECHNICAL PAPERS OF CURRENT INTEREST. S. J. Rand et al p 60–63 refs

N65-21676 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
AN/FSR-2—AN ADVANCED SYSTEM FOR PHOTO-ELECTRONIC DETECTION AND PLOTTING BEYOND RADAR RANGES
Charles B. Park *In its* Electro Optics 1964 p 7-9 refs (See N65-21675 11-14)

An 11-ton telescope having high-aperture, large-format, and photo-electronic detection was designed for satellite surveillance at distances greater than radar slant ranges. Electron image integration enhances detection, and electron-image correlation provides moving-target discrimination. Electronic data processing yields detection confirmation and satellite plotting data in near real time. Discussed are the optical system (which involves 12 image orthicons, 24 electrostatic storage tubes, and state-of-the-art fiber optics), the telescope, and the observatory—all of which are in advanced stages of construction. Author

N65-21677 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
PASSIVE INFRARED TRACKING EQUIPMENT
J. H. Woodward *In its* Electro Optics 1964 p 10–15 ref (See N65-21675 11-14)

Passive systems developed for reconnaissance and surveillance, for acquisition and tracking, for warning and detection, for guidance and control, and for monitoring and measurement are discussed. Imaging systems, detection and tracking, radiometry, and horizon and planet sensors as applications of infrared equipment are considered. Also, the characteristics of infrared systems are explored. Background radiation poses difficult discrimination problems for such equipment yielding poor false alarm rates. Application of sophisticated signal processing techniques developed and proven through extensive flight testing can improve the reliability and capabilities of future infrared trackers and seekers. E.E.B.

N65-21678 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
INFRARED FIBER OPTICS
N. Aron and L. Arlan *In its* Electro Optics 1964 p 16–19 refs Prepared Jointly with Am. Opt. Co., Southbridge, Mass. (See N65-21675 11-14)
(Contract AF 33(657)-7986)

The phenomenon of transmitting visible light by multiple internal reflections along the walls of a glass fiber was described. Visible light occupies only a portion of the useful

electromagnetic spectrum, and most forms of glass will only transmit electromagnetic radiation of wavelengths less than 2.5μ. The widespread application of infrared detection and imaging devices provides the need for longer wavelength transmission properties of fiber optic materials for the imaging of the infrared spectrum. While many materials can be used for infrared energy transmission, relatively few have properties to produce suitable infrared fiber optics. More recently, techniques have been improved for processing fiber optic materials for infrared applications, thus adding greater flexibility to the design of optical elements for infrared systems. The fundamentals and characteristics are described of infrared fiber optics, and their application to a line-to-raster converter that is believed to be the first coherent infrared bundle to be fabricated for a specific application. Author

N65-21679 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
SOME RECENT DEVELOPMENTS IN HIGH-SENSITIVITY COOLED-FILTER INFRARED DETECTORS
Harry Pullan *In* RCA, Burlington, Mass. Electro Optics 1964 p 20–22 refs (See N65-21675 11-14)

Several types of cooled infrared detectors were developed during the last five years for special applications. Recent models incorporate cooled filters which, through reduction of background radiation, enhance detectivity over restricted wavelength intervals. A prototype instrument, the Spectrotor, was developed, which gives detectivities of over 10^{11}cm/W in the 5-to 7-micron region, making use of a series of liquid-helium-cooled filters mounted on a rotating disk. This work suggests the feasibility of one extremely sensitive cooled-filter spectrometer for the whole wavelength region between 2 and 30 microns. Author

N65-21680 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
ELECTRO-OPTICAL SIGNAL PROCESSING
Michael J. Cantella and R. C. Kee *In its* Electro Optics 1964 p 23–27 ref (See N65-21675 11-14)

Effective utilization of image-scanning sensors (for example a TV pickup tube) in automatic electro-optical systems for detection, acquisition, tracking, and recognition requires signal processing equipment for extraction of desired information. Several signal processing techniques were successfully implemented for use with both standard and slow-scan systems. Techniques are described, including point-source and extended-background discrimination, image motion processing, coordinate generation, and data on performance and applications to electro-optical systems. Author

N65-21682 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RECENT DEVELOPMENTS IN PHOTO-TAPE CAMERAS
W. J. Poch *In* RCA, Burlington, Mass. Electro Optics 1964 p 33–36 refs (See N65-21675 11-14)

The basic principles and advantages of recording and storing optical images in the form of equivalent electrical charge patterns on a special kind of flexible tape are presented. The general characteristics of camera systems designed to utilize this newly developed phototape are outlined. Descriptions follow of two systems that were built to demonstrate feasibility. Advanced models of these camera systems are expected to satisfy most of the requirements applicable to a flight model. Author

N65-21683 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
VIDICON APPLICATIONS FOR SPACE-BORNE TV CAMERAS
Max H. Mesner *In* RCA, Burlington, Mass. Electro Optics 1964 p 37–41 refs (See N65-21675 11-14)

The applications of vidicons for use in space, and certain advantages of vidicons over other camera sensors are discussed. The parameters of vidicons for this use must be controlled during fabrication to meet more rigid requirements for standard features plus the requirements for additional characteristics pertinent only to spaceborne cameras. The purposes of spaceflight observations, advantages of the vidicons over other TV sensors, photoconductor choice, the importance of erasure of residual image, and vidicon parameters as related to the space mission are discussed. Further, the growth potential for spaceborne cameras is considered. Candidates for advanced systems are (1) a multiplier vidicon for higher sensitivity; (2) a large diameter vidicon for improved resolution and sensitivity; (3) a 1/2-inch hybrid for lighter weight; (4) an intensifier vidicon for greater sensitivity; (5) the image orthicon and secondary emission conductivity vidicon; and (6) the image-intensifier orthicon for the ultimate in sensitivity. E.E.B.

N65-21684 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM
Bernard P. Miller *In* RCA, Burlington, Mass. Electro Optics 1964 p 42–45 Prepared for JPL (See N65-21675 11-14)
(Contract NAS7-100; Proj. Ranger)

A technical description of the Ranger TV subsystem; the investigation into the Ranger VI mission which failed to return pictures; and the results of the successful Ranger VII mission in which 4316 pictures were obtained are presented. The Ranger TV subsystem is basically composed of six TV cameras, electronic components necessary to control the cameras, transmitter chains to send the video back to earth, telemetry components to monitor the functional components, an independent source of power for the system, a structure to house and support all of the electronic gear, and thermal-control members. The design of the subsystem is detailed. E.E.B.

N65-21685 Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
TELEVISION FOR STELLAR ORIENTATION OF THE ORBITING ASTRONOMICAL OBSERVATORY
W. Sensenig and M. Kravitz *In* RCA, Burlington, Mass. Electro Optics 1964 p 46–48 Prepared for Grumman Aircraft Eng. Corp. (See N65-21675 11-14)
(Contract NAS5-814)

The television system described has the advantages over normal star trackers of a larger field of view and a real-time display. It detects a number of stars simultaneously, which greatly aids in immediate recognition of target stars. This reduces the possibility of selecting a false target. Also, the TV subsystem acts as a check of the satellite star tracker and boresight tracker. The method of operation, vidicon, photoconductor illumination, command modes, temperature transducer, and the sun sensor are discussed. E.E.B.

N65-21687 Radio Corp. of America, Camden, N. J. Communications Systems Div.
ULTRA-PORTABLE TELEVISION CAMERA SYSTEM
J. Castleberry *In* RCA, Burlington, Mass. Electro Optics 1964 p 52–55 refs (See N65-21675 11-14)

This portable television camera system, readily set up and carried by one man, consists of camera, monitor, power supply, transmitter, and many devices to enhance operating convenience and versatility in situations where conventional cameras either could not be set up or else would be too slow or awkward. The transmitter relays by microwave radio link the television picture to a remote receiver, the video output of which, in turn, meets the standards of a conventional television broadcasting network. While the initial requirement was for operation of the man-pack camera unit a few hundred feet from the microwave receiver, the equipment produces good broadcast-quality signals at ranges of several hundred yards, and at 1.5 miles with the camera system in a helicopter and a 2-foot parabolic antenna on a ground receiver. A portable transmitter-adapter-and-antenna accessory for the camera system allows long-range operation at 20 miles. The camera system's stability is outstanding: it operates for long periods, or continuously off-and-on without needing adjustment; similarly, it may be left off for several days and yet immediately produce optimum pictures without adjustment. The system is adaptable to many TV broadcasting and other military and commercial TV applications wherever real-time visual coverage of events, foreseen or unforeseen, is of prime importance. Author

N65-21708# California Univ., Berkeley. Lawrence Radiation Lab.
MOUNTINGS AND HOUSINGS FOR LITHIUM-DRIFTED SILICON AND GERMANIUM DETECTORS
C. Eugene Miner 24 Feb. 1965 42 p refs
(Contract W-7405-ENG-48)
(UCRL-11946) CFSTI: $2.00

This paper describes a versatile cooling and housing design and several methods for mounting lithium-drifted silicon and germanium detectors. Since considerable care must be exercised to keep nonencapsulated germanium detectors in their best operating condition, greater emphasis is placed on mountings for germanium detectors than on mountings for silicon detectors. Developmental problems, materials, and methods of evacuating the housings are discussed in detail. Author

N65-21722*# McGill Univ., Montreal (Quebec).
PHOTOGRAPHY OF THE EARTH FROM SPACE AND ITS NON-METEOROLOGICAL APPLICATIONS
A. Morrison and J. Brian Bird Ann Arbor, Mich. Univ. [1964]
(Contract NASr-140)
(NASA-CR-62202) CFSTI: HC $1.00/MF $0.50

Photography from satellites and rockets constitutes a new source of information about the earth's surface. Advantages of space photography are that (1) an area hundreds of kilometers across can be shown in a single frame; (2) photographic tones are comparable, and a stereoeffect is obtainable over this area, even if it is crossed by a political boundary; and (3) uniform and frequent coverage of the entire earth can be obtained. Problems of light transmission through the atmosphere and of cloud cover are only a little greater than in aerial photography. Some existing space photography is usable, but a specially designed system would yield better results. Apart from its illustrative value, space photography could assist in mapping (1) relatively permanent distributions, e.g., geology, landforms, vegetation, generalized land-use, the extent of glaciers; and (2) ephemeral distributions, e.g., snow cover, ice cover on rivers, lakes, and the sea, forest fire burns, temporary lakes and streams, and ocean-water masses. Author

N65-21758*# Virginia Univ., Charlottesville. Dept. of Physics
A PROPOSED ORBITING X-RAY TELESCOPE
K. Ziock 5 May 1964 11 p refs Presented at the 1964 Spring Meeting of the Am. Phys. Soc., Washington, D. C., 27-30 Apr. 1964
(Grant NsG-578)
(NASA-CR-56815) CFSTI: HC $1.00/MF $0.50

The design of a totally reflecting X-ray telescope for observation of wavelength regions above the earth's atmosphere is discussed. The instrument should incorporate one or more concentric slices of paraboloids arranged to have a common focus and consisting of medium density low Z materials. Examination of the elements and inorganic compounds for their highest electron density, and the determination of the inner radius for largest angle of reflection—and thereby the shortest wavelength at which the entire telescope is effective—showed that a BeO mirror is the best choice at long wavelength and is only insignificantly less effective at short wavelength. Its manufacture by surface oxidation of an evaporated Be film is feasible. G.G.

N65-21761*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
DEVELOPMENT OF IMPROVED SENSING METHODS AND DEVICES FOR STAGE CHECKOUT. PART II: INFRARED MEASUREMENTS IN REAL TIME. VOLUME I: DESIGN STUDIES OF A REAL-TIME INFRARED MEASUREMENTS SYSTEM Final Report, Phase A, Jul. 1964-Jan. 1965
15 Jan. 1965 79 p
(Contract NAS8-11715)
(NASA-CR-62237) CFSTI: HC $3.00/MF $0.75

This report describes an investigation of the concept of using an infrared vidicon camera system for real-time measurements of infrared radiation from electronic circuits and components. Investigations to determine the requirements of the overall system and of individual components of the system are described. Design recommendations for a prototype infrared measurements system are also given. The overall system is described under the following headings: functional concept, mechanical design concept, IR vidicon camera, signal processing and display, optics, cryogenics, and calibration source. Author

N65-21892# Battelle Memorial Inst., Columbus, Ohio.
OPTIMIZATION OF PERFORMANCE OF SILICON-JUNCTION FAST-NEUTRON DOSIMETER Final Report, Jul. 1, 1963-Jan. 31, 1965
Gordon Kramer, O. J. Mengali, and H. C. Gorton 31 Jan. 1965 48 p refs
(Contract DA-36-039-AMC-03224(E))
(AD-460412)

The annealing behavior of neutron-irradiated silicon-diffused p-n junction dosimeters and the bulk silicon from which the dosimeters were fabricated have been studied. Float-zone grown and pulled silicon crystals were used. In addition, the application of epitaxial techniques to the fabrication of silicon dosimeters and the annealing characteristics of such devices were investigated. The annealing studies indicate significant differences in annealing characteristics between p- and n-type based devices and between float-zone and pulled devices. Those fabricated from n-type float-zone material were most stable and showed no annealing at room temperature. The devices fabricated from epitaxially processed wafers exhibited very low carrier lifetimes and are inferior to presently available dosimeters. Author

N65-21940 United Kingdom Atomic Energy Authority, Harwell (England).
FILM THICKNESS MEASUREMENT USING A FLUORESCENCE TECHNIQUE. PART I: DESCRIPTION OF THE METHOD
C. E. Hewitt, P. C. Lovegrove, and B. Nicholls 1964 19 p refs
(AERE-R-4478)

A new method is described for the measurement of the thickness of liquid films. A fluorescent dyestuff is added to the liquid and the film is irradiated at the required measurement point by a focused beam of monochromatic light. This excites a fluorescence of a different wavelength in the liquid. The emitted light is collected, separated from adventitiously reflected components of the incident light, and metered. The intensity of the light emitted is a determinable function of the liquid film thickness. Author

N65-21942 United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
MONITORING LIQUID STREAMS FOR PLUTONIUM IN THE PRESENCE OF AMERICIUM
G. F. Snelling Oct. 1964 25 p refs
(AERE-R-4498) HMSO: 3s 6d

In chemical plant streams containing dissolved fuel elements of high burnup, existing alpha counting monitors for measuring plutonium may sometimes be inapplicable due to interference from americium 241. In such instances a monitor able to discriminate between plutonium and americium is required, and the aim of the present work is to provide information on which the design of such a monitor might be based. Author

N65-21943 United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
THE MEASUREMENT AND CONTROL OF GAS TEMPERATURE IN THE FINGAL PROCESS
M. N. Elliot and J. R. Grover Dec. 1964 26 p refs
(AERE-R-4512)

During development of the FINGAL process for incorporating highly radioactive fission product waste into glass it was found important to maintain the temperature of the gas within the process between certain limits. This report describes methods for measuring these temperature limits and examines possible methods of controlling gas temperature in the process. Author

N65-21959# Royal Aircraft Establishment, Farnborough (England).
THE TECHNIQUE OF MEASURING THE FORCE EXERTED BY A PARACHUTE DURING OPENING
D. B. Cobb London, Min. of Supply, Oct. 1959 28 p refs
(RAE-TN-MECH-ENG-301)

A technique for the measurement of parachute opening forces by a mechanical instrument is described. The results of consistency tests of the apparatus are presented, and forces observed at the various stages of opening are related to high speed cine photographs of the process. Author

N65-22068# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UHF RANGE WAVEGUIDE ARRANGEMENT FOR EXCITATION OF H_{30} TYPE WAVE IN A RECTANGULAR WAVEGUIDE
V. S. Buryak 15 Feb. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 155188 (Class 21a), Apr. 1962 2 p
(FTD-TT-64-917/1+2; AD-611550)

The object of the invention is a waveguide arrangement of uhf range for excitation of H_{30}-type wave in a rectangular waveguide. A rectangular waveguide of large cross section is butt jointed with a rectangular waveguide of smaller cross section, excited by H_{10} wave, and along the axis of the larger waveguide are situated two longitudinal metal plates, serving as a phase displacing device for the central channel. Author

N65-22074# Rocketdyne, Canoga Park, Calif.
FEASIBILITY INVESTIGATION OF HEAT-FLOWRATE MEASURING TECHNIQUES Final Report, Dec. 1962–Aug. 1963
J. J. Vrolyk and P. A. Kinzie Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jan. 1964 151 p refs
(Contract AF 33(657)-8109)
(R-5286; RTD-TDR-63-4077; AD-431189)

The design of a zero blockage heat–flowrate transducer is discussed. The measuring technique is one in which all of the flow measured is normal to and passes through two precisely located cross sections of a thermally conducting material, and the electrical output is a precise measure of the integral average differential temperature between these cross sections and is proportional to the heat flowrate through them. Fabrication techniques are considered, and a step by step description of the assembly of an experimental transducer is described. The finished transducer was calibrated in the heat-flux range of 0 to 2.5 Btu/sec-sq in. and was used to measure steady-state and transient heat flux as high as 4.1 Btu/sec-sq in. Hot-side temperatures up to 865°F (463°C) were reached. It was concluded feasible to use miniaturized transducers which can be installed directly in thin walls without special cooling provision to measure high steady-state or dynamic heat flux. Author

N65-22147# Naval Civil Engineering Lab., Port Hueneme, Calif.
TESTS OF A MOTION PICKUP OF THE INFRA-RED TYPE
Floyd E. Nelson Oct. 1964 23 p ref
(N-623; AD-611419) CFSTI: $1.00

A pickup suitable for the measurement of ocean water level variations is described. Tests were conducted in the laboratory of a development model of the motion pickup using an infrared source (light bulb) as the motion sensor. Specifically, an infrared sensitive photocell is positioned so as to receive energy from a source only when a hole in the rim of a wheel is in the plane of the source and the center of the wheel. Then, as the wheel is caused to rotate, the cell receives a pulse of energy, through the hole from the moving source, and thereby activates a time measuring circuit. The wheel continues to rotate until the hole is next positioned so that the cell receives a pulse of energy from a fixed source. This causes the time measuring circuit to stop and from calibration data the position of the moving source relative to a given horizontal plane is calculated and recorded (plotted). Successive positions of the moving source are calculated and recorded to provide a continuous record as a function of time of the displacement of the moving source. TAB

N65-22182*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THE EVALUATION OF SEVERAL COMMERCIALLY AVAILABLE ACCELEROMETERS
Tom D. Finley [1964] 27 p Presented at the I.R.I.G. 4th Transducer Workshop, Wright-Patterson AFB, Ohio, 18–19 Jun. 1964
(NASA-TM-X-51791) CFSTI: HC $2.00/MF $0.50

This paper discloses some problems encountered during accelerometer calibrations and discusses some techniques, in

particular the continuous plot, which can be used to reveal instrument errors. The first portion of the paper deals with one accelerometer of the servo type, Brand A; the second part is a collection of findings on accelerometers of different types. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-21172# Beryllium Corp., Reading, Pa.
PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES Quarterly Progress Report, Jul. 1–Sep. 30, 1964
J. F. Blum [1964] 24 p
(Contract DA-36-039-AMC-01481(E))
(QPR-5; AD-612775)

Dielectric properties were evaluated on specimens produced by various fabrication techniques. The average dielectric strength values for samples fired at 1560° C were about 250 V/ml. Gross differences were not noted as a function of fabrication technique. Dielectric constant and loss factor values were about 6.4 and 7×10^{-4} respectively, for as-sintered specimens. Machined samples showed an increased dielectric loss over the as-sintered specimens when measured following a water pretreatment. Firing temperature vs grain size studies on 99% BeO compacts showed that average grain size ranged from about 13μ at 1460° C to 33μ at 1560° C. Average grain sizes were fairly constant in the firing temperature range 1510° to 1560° C, but a significant change was noted at 1490° C. Flexural strength results showed a slight difference between test specimens prepared from fine and coarse grained samples with an average value of 26 900 psi for 13μ material and 24 200 for 33μ test specimens. Author

N65-21174# Rotron Mfg. Co., Woodstock, N. Y.
THE DEVELOPMENT OF A GAS LUBRICATED BEARING BLOWER ASSEMBLY FOR USE IN AN AN/TED-9 RADIO TRANSMITTER Interim Development Report, 3 Nov. 1964–2 Feb. 1965
15 Mar. 1965 36 p refs
(Contract NObsr-87522)
(AD-613032)

Transmitter evaluations have established the design parameters for the gas-bearing blower and electronic converter package. Test rig investigations have been conducted to determine the effect of bearing geometry variations on the bearing performance of cylindrical journal bearing. Several evaluations were also conducted on repulsive-type permanent magnet thrust bearings. Author

N65-21177# Rock Island Arsenal Lab., Ill.
INVESTIGATION OF VOLATILE CORROSION INHIBITOR ADDITIVES FOR STANDARD OPERATING OILS TO IMPROVE THEIR PRESERVATIVE CHARACTERISTICS
Joseph H. Weinberg and Gerald Pributsky 21 Dec. 1964 24 p
(RIA.-64-3577; AD-612732)

The work demonstrated the feasibility of using carefully selected concentrates to improve the preservative properties of an operating lubricant. However, unpredictable compatibility problems may prevent application of this process. Of three concentrates found that would provide vapor phase protection comparable to that of Specification MIL-L-46002 VCI oil, and exhibit only slight sedimentation in compatibility tests with operating lubricants, only one had the supply and logistics properties desirable. Concentrates in liquid form were revealed best suited because solubility problems were encountered with the powdered form of concentrate. The type of diluent which is part of the concentrate can also produce detrimental effects on a product when added to an operating oil as evidenced by drastic changes in viscosity, pour point and flash point. Author

N65-21199# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON GENERAL MACHINE CONSTRUCTION [LITERATUUROVERZICHT, ALGEMENE WERKTUIGBOUW]
25 Dec. 1964 24 p refs In DUTCH *Its* 2nd Yearly Issue, No. AW-17

Brief reviews of literature on general machine construction are described. Contents include firing motors, gas and steam turbines, steam installations, cooling and ventilation, machines, machine parts and oiling, materials, and technical news. L.S.

N65-21200# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON DOMESTIC TRANSPORTATION [LITERATUUROVERZICHT, INTERNTRANSPORT]
Jan. 1965 13 p refs In DUTCH *Its* No. 44

Abstracts on handling, storage, and transportation problems of industry are presented. Among the subjects covered are: automated warehouses; high-speed bottling; mechanization; computers; man-hours reduction; tools; distribution costs; remote control; gravity material handling; tractors; loaders; crawlers; trucks; cranes; ball-bearing slewing rings; 2 1/2-mile potash conveyor; sorting systems; fruit conveyance on 32- × 48-inch pallets; palletization; sorting and counting in food production; counting scales; containers for powdery goods; reclaim-rubber process handling; accident prevention; ferry service; rust and corrosion; aluminum alloy cladding; unit loading; warehouse control; mechanized fertilizer plant; packaging; and strapping as an aid to production. E.E.B.

N65-21303*# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
BEARING LUBRICANT ENDURANCE CHARACTERISTICS AT HIGH SPEEDS AND HIGH TEMPERATURES Progress Report No. 7, Apr. 1–Jun. 30, 1964
C. J. Wachendorfer [1964] 33 p refs
(Contract NASw-492)
(NASA-CR-57982; AL-64T035)

Ten consumable-electrode vacuum-melted (CVM) WB-49 tool steel 7205 angular contact ball bearings were tested at 20 000 rpm, 365 lbs thrust load and mean temperatures up to 610° F. Two hydrocarbon oils, Kendex bright stock 0846 and Socony XRM-109F and the ester base oil, Socony RM-139A, were used to lubricate the bearings. Also, cage designs and materials evaluation continued to aid in selecting the most desirable design which would eliminate the cage guide wear experienced in previous testing and will be utilized in bearings yet to be tested. An associated research program to select the most wear-resistant cage materials for application in high

temperature bearings continued with recent testing at temperatures up to 700° F, using polyimide plastic cage specimens and two of the candidate high temperature lubricants, Monsanto OS-124 and Esso FN-3157. Author

N65-21319*# ARINC Research Corp., Washington, D. C.
ANALYSIS OF SPECIFICATION SYSTEMS FOR THE PROCUREMENT OF HIGH-RELIABILITY PARTS
Bryce Sigmon May 1964 76 p *Its* Publ.-304-01-1-435
(Contract NASw-831)
(NASA-CR-57941) CFSTI: HC $3.00/MF $0.75

A qualitative analysis of six specification systems for the procurement of high-reliability components is presented. Related subject headings in the six systems are compared with regard to cost, delivery time, and reliability assurance. Ratings are assigned to each of the subject headings on the basis of the relative effect each system has on these three factors. In addition, the current status of procurement specifications for high-reliability devices is appraised. This appraisal covers some of the more serious problems associated with current procurement practice. A relatively new concept—line qualification—is presented as a means of alleviating these problems. Author

N65-21370# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METALS JOINING Review of Recent Developments
R. M. Evans 26 Mar. 1965 4 p refs

The brazing, bonding, and welding of refractory metals, and the welding of high-strength steels are reviewed. Also, the electrodes used for resistance-heated bonding are tabulated. Bonding processes which require only a 20-sec cycle and which produce joints equal in strength to the base metal when coated for oxidation resistance have been developed. The development of a HY 180/210 steel having a Charpy V-notch energy absorption of about 50-ft-lb was shown to be feasible. There is some question whether or not weldments in these alloys will be fracture tough for large flaws and high-stress concentrations. It was also noted that a 5Ni-Cr-Mo-V steel has been developed which meets most of the requirements of a HY 140 steel. When this alloy is MIG welded with a 2Mn-2Ni filler metal, good explosion-test results are obtained. Other significant results are reviewed and evaluations tabulated. E.E.B.

N65-21384# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNITS CR-(XM-47)/U Quarterly Report, 1 Nov. 1964–31 Jan. 1965
John H. Sherman, Jr. [1965] 17 p
(Contract DA-36-039-AMC-02232(E))
(QR-6; AD-613292)

At 0.220-in. diameter a fully contoured 7-Mc/s crystal design yields a resistance of 35 ohms. Success at 7 Mc/s indicates the usability of 0.220-in. diameter, so all units will be made at this diameter. Epoxy closure was used with old style bases in plate design studies. Experiments with low voltage electron beam welders shows them adequate, but the triode gun is necessary for this kind of welding. Weld beam power of the order of 100 W is indicated. Author

N65-21407# Philco Corp., Lansdale, Pa.
PEM FOR GOLD-DOPED GERMANIUM INFRARED DETECTOR TYPE IR400 Quarterly Progress Report, 1 Oct.–31 Dec. 1964
A. Guimento [1964] 74 p
(Contract DA-36-039-AMC-01464(E))
(QPR-8; AD-612960)

Preproduction tests were made. The samples underwent visual and mechanical inspection and the cell resistance, optimum bias, and detectivity were tested. The remaining electrical parameters, frequency response, effective time constant, noise spectrum and special response, were measured. Results of these tests are presented. TAB

N65-21412# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMILARITY CRITERIA OF MAGNETOHYDRODYNAMIC PHENOMENA AND LOSSES IN ELECTROMAGNETIC POWER IN A CONDUCTIVE LIQUID LAYER BETWEEN ROTOR AND STATOR OF AN ASYNCHRONOUS ELECTRIC MOTOR
A. V. Ivanov-Smolenskiy and G. S. Tamoyan 5 Mar. 1965 17 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved., Energ. (Minsk), no. 6, 1964 p 32–39
(FTD-TT-65-171/1+2; AD-612416)

A method is described for finding similarity criteria for electromagnetic and mechanical power losses in a layer of conductive liquid or liquid metal. Filling the air gap of a pump motor. Scale coefficients which determine the magnitudes of losses in power are considered. TAB

N65-21445# Mechanical Technology, Inc., Latham, N. Y.
AN EXPERIMENTAL STUDY OF FRICTION IN ELASTO-HYDRODYNAMIC LUBRICATION
M. D. Longfield 28 Aug. 1964 26 p refs
(Contract Nonr-3729(00)(FBM))
(MTI-64TR63; AD-610134)

The main features of the apparatus were described by Orcutt. Two 1/4-inch-wide, 6-inch-diameter disks were mounted with their axes horizontal, each being driven independently through Vee-belt drives by infinitely variable-speed electric motors. The disks were made to roll or roll and slide on their peripheral surfaces while loaded together. The upper steel disk was held in a lever assembly which was supported at one end by a self-aligning pivot. Load to the disks was applied by applying dead weights to the other end of the lever arm. The lower disk, made of glass, was driven at the same or lesser speed than the steel disk. Both disks were polished on their peripheries to a surface finish of a few microinches. Provisions were available for the true alinement of the disks to provide a symmetrical distribution of load across their width. A jet of lubricant was supplied to the inlet side of the contact, and an intercooler was incorporated in the oil circuit to minimize oil supply temperature fluctuations. Author

N65-21497# Joint Publications Research Service, Washington, D. C.
SEALING OF POROUS CARBON-GRAPHITE MATERIALS BY PYROLYTIC CARBON IN THE PROCESS OF THEIR HEAT TREATMENT IN AN ATMOSPHERE OF NATURAL GAS
V. K. Pechik, K. I. Makarov, and P. A. Tesner 14 Apr. 1965 20 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), no. 11, Nov. 1964 p 8–13
(JPRS-29593; TT-65-30739) CFSTI: $1.00

The results of experiments on sealing porous artificial graphite by pyrolytic carbon, and the influence of thermal transformations occurring in the gas phase are presented. The rate of carbon formation on a surface, the structure and

properties of the carbon being formed, and the degree of sealing of porous carbon materials with carbon, in the case of heterogeneous pyrolysis of natural gas, depend upon the magnitude of free volume above the surface and the depth of thermal transformations occurring in the gas phase. Also, an increase of the depth of thermal transformation of initial hydrocarbons in the gas phase intensifies the process. Considerable sealing of coarse porous graphite by pyrolytic carbon with an apparent density of less than 1.0 g/cc is possible. Further, an increase in speed of formation of carbon on the surface as a result of the deeper transformation of hydrocarbons in the gas phase impairs the properties of the carbon coating. E.E.B.

N65-21505# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD FOR JOINING METAL TO CERAMIC

V. B. Rabkin 18 Feb. 1963 5 p Transl. into ENGLISH from Russian Patent No. 147902 (Appl. No. 703573/25) 5 Sep. 1959 1 p

(FTD-TT-62-1794/1+2+4; AD-299656)

A method of producing an alloy with thermal properties similar to that of a ceramic to which it is to be bonded is discussed. In selecting the components of the alloy, it is essential that (1) the components not form solid solutions nor intermetallic compounds; (2) the melting point of the more easily fusible component be above the sealing temperature and above the upper limit of the working temperature; (3) one or more of the components possess the chemical and physical properties desired and have good workability; and (4) the more easily fusible component wet the more difficult fusible component. The equation for matching the coefficient of expansion of the alloy to that of the ceramic is given by $a_n = a_1X + (1-X)a_2$, where a_n is the coefficient desired for the alloy, a_1 and a_2 are the coefficients of expansion for the components, and X is the volumetric concentration of the metal with the coefficient of expansion a_1. E.E.B.

N65-21506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF OBTAINING MONOCRYSTALLINE DISKS OF LARGER DIAMETER

L. M. Belyayev, O. F. Dobrzhanskiy, and Kh. S. Bagdasarov 23 Apr. 1963 4 p Transl. into ENGLISH from Russian Patent No. 147576 (Appl. No. 736971/23, 3 Jul. 1961) 1961 p 1–2

(FTD-TT-63-63/1; AD-420451)

A method for the production of monocrystalline disks of large diameter is described. The monocrystalline disks are prepared by the direct growth of the crystal from a melt with the aid of a cylindrical primer revolving about its axis in a horizontal position in the melt. The rate of growth is controlled by the vertical displacement of the primer cylinder in or out of the melt. The method is reported to improve the quality of the crystalline disks by reducing residual stresses. Also, because of the simplicity of the method, it is less expensive than previous methods used to produce crystalline disks. E.E.B.

N65-21522# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ULTRASONIC DETECTION OF INITIAL MATERIAL FATIGUE CRACKS UNDER OPERATING CONDITIONS

Pal Reti, Jozsef Kalman, and Gabor Barna 19 Mar. 1965 15 p Transl. into ENGLISH from Gep (Hungary), no. 1, 1964 p 11–16

(FTD-TT-64-1004/1+2+3+4; AD-460317)

Ultrasound was used to study fatigue phenomena in normalized manganese–titanium steel bars under cyclic stressing. Ultrasonic flaw detection was achieved using a horizontal vibrator with a modified gripping fixture, test bar shape, and clamping head. It was possible to detect the initial crack at the moment of its onset and to determine the speed of crack propagation using this method. Creep phenomena and flaw echo are discussed. Ultrasound is recommended for studying other forms of stress such as cyclical bending. Speculation is made regarding the applicability of this method to complete structures. S.C.W.

N65-21556# Battelle Memorial Inst., Columbus, Ohio. Metals Joining Div.

DEVELOPMENT OF METHODS OF MAKING NARROW WELDS IN THICK STEEL PLATES BY AUTOMATIC ARC WELDING PROCESSES Final Report, 24 Mar. 1962–23 Mar. 1964

J. W. Nelson, M. D. Randall, and D. C. Martin 23 Mar. 1964 68 p ref

(Contract NObs-86424)

(AD-454864)

A new welding method was developed and welding parameter ranges were established for automatically welding thick steel plates in all positions. This process, called Narrow-Gap welding, has been extensively evaluated for application to welding thick HY-80 low-alloy steel plates specifically for use in submarine hull fabrication. Narrow-Gap welds are made by the gas-shielded, consumable-electrode process. The most distinguishing feature of the process is the use of a very narrow, square-butt joint (with approximately 1/4-inch gap between plates) rather than conventional Vee- or U-groove joint preparations normally used for arc welding. Two variations of the process, one using a single electrode wire and the other using twin wires, have been developed. The twin-wire technique was developed to assure good sidewall fusion despite variations in width of the joint opening. Welds have been made in the flat, vertical, and overhead positions using the Narrow-Gap process. Author

N65-21569# Joint Publications Research Service, Washington, D. C.

VACUUM DIFFUSION WELDING OF HIGH-MELTING METALLOID COMPOUNDS WITH HIGH-MELTING METALS

L. Ya. Popilov ed. 13 Apr. 1965 13 p refs Transl. into ENGLISH from the book "Novyye Materialy v Mashinostroyenii" Leningrad, 1964 p 124–134

(JPRS-29550; TT-65-30713) CFSTI: $1.00

Investigations were conducted on vacuum diffusion welding of (1) hot pressed carbide samples of titanium, molybdenum, and tungsten with themselves and with the high melting metals molybdenum and tungsten in a vacuum of 10^{-2} to 10^{-3} mm Hg, and (2) carbides of zirconium and niobium with the high-melting metals niobium, tantalum, molybdenum, and tungsten in a vacuum of 10^{-3} mm Hg at varying pressures. All welding was carried out in the temperature range 1300° to 2000° C with holding for 5 to 15 minutes, and the quality of the welded seam was analyzed by metallographic investigation. Titanium carbide did not undergo welding with tungsten. All other investigated substances underwent diffusion welding at comparatively low temperatures in the low vacuum. It was found that the melting temperature of the carbide is not the determining factor in the selection of optimal welding conditions, and that the quality of the welded seams depends on the welding temperature and the nature of the substance. G.G.

N65-21624# Sandia Corp., Livermore, Calif.
PRINTED CIRCUIT LABORATORY MANUAL
A. D. Andrade and E. E. Alford Mar. 1965 85 p Sponsored by AEC CFSTI: $3.00

A description of the laboratory and a step-by-step outline of the manufacturing techniques for the fabrication of etched circuit boards are presented. Single and double-sided printed circuit boards for breadboard, plated, and nonplated types are included. Also, the double-sided printed circuit board plated through holes is described. Further, data on the following are appended: (1) copper-clad laminated plastic sheet; (2) drill size determination for plating through holes; (3) copper deposition mixture instructions; (4) standard carbide drill sizes; (5) printed circuit laboratory materials; (6) etching rules; (7) copper strike mixture instructions and current density chart; (8) copper pyrophosphate plating solution mixture instructions and current density chart; (9) lead-tin plating solution mixture instructions and current density chart; (10) analysis of plating solutions; (11) dye photo printing process; and (12) gold strike and gold plating solution mixture and current density charts. E.E.B.

N65-21698 Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations
A MATHEMATICAL MODEL TO PREDICT PERFORMANCE RELIABILITY OF A MANUFACTURED COMPONENT WITH MULTIPLE CRITICAL CHARACTERISTICS BY NONDESTRUCTIVE TESTING
Eberhard H. Bauer 4 Nov. 1964 12 p
(Rept.-9300-IS; AD-609964)

A mathematical model was developed for the estimation of the reliability of delivered items. The model is based on a series of assumptions about probabilities in manufacture and quality control. Quality control inspection is assumed to be of a nondestructive type. The mathematical model also indicates the sensitivity of the reliability estimate with respect to changes of the probabilities in manufacture and quality control, and an optimization procedure for a reliability increase with respect to costs is outlined. Some considerations for establishing a confidence level for the reliability estimations are added. Author

N65-21765*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center
INVESTIGATION OF PRESSURE PREDICTION METHODS FOR RADIAL FLOW IMPELLERS, PHASE II Final Report, Mar. 1964–Feb. 1965
W. E. Young and H. F. Due 8 Mar. 1965 57 p refs
(Contract NAS8-5442)
(NASA-CR-62246; PWA-FR-1276) CFSTI: HC $3.00/MF $0.50

The program consisted of experimental investigation of various factors affecting distribution of pressure along radial-bladed or smooth rotating disks and application of test results to formulate an accurate method for predicting pressure distribution. The first phase was devoted entirely to incompressible flow conditions using water as the test fluid; the second extended the water flow tests to include rotor end effects, following which the entire program was repeated with liquid hydrogen as the test fluid. In all tests, simultaneous investigation of radially outward and inward flow conditions was made. Pressures at the inlet and discharge and at several radial stations, rotor speed, fluid inlet and discharge temperatures, and flow rate were measured and recorded for each test using a high speed data recording system. In addition, high-frequency blade-to-blade pressure data were measured and recorded on magnetic tape for the bladed-rotor tests. Data from these tests were used to develop regression equations with which pressure distribution for low flow radial impellers may be accurately predicted. Author

N65-21779*# Aluminum Co. of America, Pittsburgh, Pa. Alcoa Research Labs.
ARC STABILITY AND MELTING CHARACTERISTICS OF WELDING WIRE FOR USE WITH 2219 ALUMINUM ALLOY PLATE
J. H. Dudas 30 Nov. 1963 68 p refs *Its* Rept.-2-63-39
(Contract NAS8-5132)
(NASA-CR-62260) CFSTI: HC $3.00/MF $0.75

New experimental 2319-type electrodes, M788 (2319 + 0.25 Zn) and M789 (2319 + 1.0 Zn) were developed to provide a wider range of stable arc length and arc voltage than 2319 for gas metal-arc (MIG) welding 2219 plate. They permit a stable arc to be maintained with less precise control of weld conditions and a more favorable bead shape and size during out-of-position welding. Welds with these fillers were equal to or better than 2319 welds in tensile strength, freedom from cracking, and electrochemical potential in the weld zone. Electroplating 2319 filler wire with zinc improved arc stability. Zinc was preferred to cadmium, magnesium, or calcium as a stabilizing addition. The 2319-type electrode modified by lowering the copper content or adding silicon or beryllium did not have significantly improved arc stability. Strength and ductility of welds were decreased by these composition modifications. Solution heat treating 2319 electrode reduced $CuAl_2$ particles in the wire microstructure but did not significantly improve arc stability. Author

N65-22030# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
ANALYZING RELIABILITY DATA AND DESIGNING ACCEPTANCE TESTS
Cynthia Kolb Whitney Oct. 1964 39 p
(Contract AF 04(694)-553)
(E-1705; AD-610850)

Persons designing testing programs to specify reliability functions and failure rates need theoretical means of assigning confidence intervals to the quantities obtained. Also, persons designing acceptance tests for items with unknown reliability functions need simple, general methods of test design which do not rely on the myriad specialized tables for specific mathematical models available in the literature. The two problems are really opposite ways of looking at the same theoretical structure. The theoretical structure is examined, and solutions to the problems are posed. Author

N65-22083# Aeroprojects, Inc., West Chester, Pa.
SEALING OF PROPELLANT CONTAINERS BY ULTRASONIC WELDING, PHASE III
Dec. 1964 31 p refs
(Contract DA-36-034-AMC-0061(A))
(RR-65-13; AD-610948)

Ultrasonic ring welding was successfully used to produce hermetic closures of propellant containers requiring formation of the welds in recessed cavities in the container bodies. The container body, Picatinny Ordnance Part No. XP-113711, was used without modification. The cover material was 0.005-inch-thick 3003-H19 aluminum alloy. After ultrasonic cleaning, the components were welded with a laboratory-type ultrasonic ring welding machine providing a power handling capacity of up to 10 kilowatts, modified to incorporate a special torsional coupling element, ring welding tip, and two-part welding anvil that provided a threaded receptacle for the container body. Representative assemblies, each filled with 65 grams of M10 propellant, were welded at 5400-watts electrical power, 1500-pounds clamping force, and 0.5-second weld time. Metallurgical evaluation indicated sound bonds, and

hermetic sealing was verified by helium-leak and ethylene-glycol-submersion tests. Fifty such assemblies were delivered to Picatinny Arsenal for further evaluation. The process was considered applicable to production welding of these assemblies at rates substantially in excess of 1500 units per hour. Author

N65-22101# Los Alamos Scientific Lab., N. Mex.
TECHNIQUES FOR HANDLING ALPHA-ACTIVE SPECIMENS FOR ELECTRON MICROSCOPY
Dana L. Douglass 19 Mar. 1965 19 p refs
(Contract W-7405-ENG-36)
(LA-3200) CFSTI: $1.00

Two replication procedures, suitable for use with smooth or rough surfaces of alpha-active specimens such as plutonium, are described. In addition, techniques for handling and examining thin foils of delta plutonium, as well as contaminated replicas in the electron microscope, are outlined. Author

N65-22107# Western Gear Corp., Lynwood, Calif. Research Dept.
PROCESS DEVELOPMENT AND EVALUATION OF PLASMA SPRAYED BERYLLIUM
T. J. Roseberry, M. L. Headman, and F. L. Parkinson Sep. 1964 37 p ref
(RR-649-229)

These investigations showed that plasma spray fabrication of thin-walled beryllium shapes is feasible. Dimensional stability and repeatability of the fabricated shapes using optimized techniques are high. As a result of employing a gas pressure densification technique, the following properties can be obtained: (1) high strength—up to 67 000-psi U.T.S.; (2) high density—between 98% to 99% of theoretical density; and (3) completely isotropic grain structure with no preferred orientation due to fabrication. The nature of the fabrication process is such that the risk of contamination to both personnel and equipment is minimized. Author

N65-22166*# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
BEARING LUBRICANT ENDURANCE CHARACTERISTICS AT HIGH SPEEDS AND HIGH TEMPERATURES Progress Report No. 10, Jan. 1–Mar. 31, 1965
C. J. Wachendorfer [1965] 58 p refs
(Contract NASw-492)
(NASA-CR-62341; AL-65TO31) CFSTI: HC $3.00/MF $0.50

Longer bearing life was obtained with polyphenyl ether type lubricants than in previous tests. A modified polyphenyl ether having a −20° F pour point operated in one test at 500° F at 42 800 rpm and 365-lbs load for 58.8 million revolutions without surface stress. Also, a six-ring fluid operated in another test at 598° F for 50.3 million revolutions with only slight glazing of the inner-ring ball track. Two of four tests with the five-ring lubricant in an air environment survived for appreciable lives, which may reflect an improved boundary lubricating characteristic of this oxidation-resistant fluid. A single test was performed at 580 lb load with M-1 bearings and an ester-base lubricant at 500° F to establish the limiting load for this bearing-lubricant combination. One bearing smeared after 115.3 million revolutions at 500° F, while the other bearing operated for the same life at 484° F without surface stress. Results of endurance testing at 42 800 rpm, completed on three groups of statistically similar 7205 bearings, are also reported. E.E.B.

N65-22167*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT OF THE ALL-WELDED COMMON BULKHEAD Fifth Monthly Progress Report, 1–30 Nov. 1964
A. C. Robertson [1964] 21 p
(Contract NAS8-11696)
(NASA-CR-62342; SM-48094) CFSTI: HC $1.00/MF $0.50

Various tungsten inert gas (TIG) and molybdenum inert gas (MIG) welding techniques were compared in a project to develop a welding method for simplified construction of common bulkheads for Saturn V upper stages; the final choice of method must be one in which both faces are simultaneously welded from honeycomb sandwich segments. From flat panel tests, photomacrographs are shown for specimens of TIG welds with integral chill, grooved joint, and added filler metal; for vertical MIG welds in aluminum alloy with backing strip, welding conditions, procedures and nondestructive inspection results are summarized, and photomacrographs are presented. Tension tests results are given which indicate that the TIG welds in aluminum alloy had consistently better mechanical properties than the MIG welds; based on these results, the two TIG-welded joints—by integral chill and external chill TIG methods—were selected for further testing and consideration. J.M.D.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-21219# Library of Congress, Washington, D. C. Aerospace Technology Div.
GAS BREAKDOWN IN A LASER BEAM
Simon Kassel *In its* Foreign Sci. Bull., Vol. 1, No. 3, Mar. 1965 p 1–8 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

A review is presented of recent Soviet research on gas breakdown in the focused laser beam. This problem is explored by several distinct theoretical methods, drawing specialists from different fields, and by independent experimental investigation. Author

N65-21342*# Philco Corp., Blue Bell, Pa. Applied Research Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATION ON MODULATION-INDUCING RETRODIRECTIVE OPTICAL SYSTEMS (MIROS) Monthly Progress Report, 20 Dec. 1964–20 Jan. 1965
G. K. Chang and P. H. Cholet 15 Feb. 1965 7 p refs
(Contract NAS5-9765)
(NASA-CR-57922; MPR-3) CFSTI: HC $1.00/MF $0.50

Experimental work on GaAs lasers, the generation of alkaline line by stimulated Raman emission, the band-edge modulator, and the cesium bulb are reported. GaAs lasers were prepared which lased at 77° K at 8340 Å with a threshold of 4×10^3 amp/cm^2, using 2 μsec pulses at a low repetition rate. Also, a negative resistance was obtained in the forward current–voltage characteristic of the cadmium-diffused diodes. A typical diode will be insulating to 2 V before dropping back to 1.5 V and conducting. To improve the pumping efficiency of the ruby laser, a special silver plating was applied to the existing laser cavity with satsifactory results. The cesium sources previously used for optical pumping were replaced with sources using argon as the buffer gas to avoid the strong

8952 Å line of xenon. The degree of rf excitation was strongly dependent upon the argon pressure. The best sources (25% pumping efficiency) had pressures around 1 mm Hg. E.E.B.

N65-21372# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
BULLETIN OF THE INSTITUTE OF SPACE AND AERONAUTICAL SCIENCE, VOLUME I, NO. 1
Koichi Oshima, Masao Yamamoto, Katsutaka Sugaya, and Yuko Oshima Jan. 1965 59 p refs In JAPANESE; ENGLISH summary

Applications of a Ne–He gas laser to conventional schlieren method and Mach–Zehnder interferometry are very successful. The high brightness of the laser light source results in such sensitive schlieren photographs that the maximum sensitivity obtained is actually limited by diffraction of the laser light beam due to the models. The high monochromaticity and brightness of the laser light make adjustments of Mach–Zehnder interferometers very easy, and high quality interferograms can be obtained for fields with very large optical path differences beyond millions of the fringe shifts. Such high interference of the laser light in Mach–Zehnder interferometry suggests several new applications—for instance, measurements of temperature fields in transparent liquid or solid and strain analyses of solid models. A few other laser applications to gasdynamic testing are proposed, including heterodyne detection of two laser lights to analyze an interference of light wave with a plasma. Author

N65-21554# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
A STUDY OF THE FOCUSING AND COLLIMATION PROPERTIES OF THE PULSED MULTI-MODING RUBY LASER
Neil R. Kilcoyne (M.S. Thesis) 31 Dec. 1964 52 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-19; AD-460461)

Classical coherence theory as presented by Wolf with the modification proposed by Neugebauer is used to mathematically and experimentally describe the collimation and focusing of the time averaged intensity of pulsed multimode laser radiation. Measurements of the double-slit Fraunhofer pattern and the near- and far-zone intensity patterns were made on two pulsed ruby lasers by both still and streak photography to examine the spatial coherence and the collimation of the beam. Results showed that the time-averaged collimation and focusing characteristics of the beam can be treated as the superposition of noncoupled spatially coherent modes. Author

N65-21555# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
TEMPORAL DEPENDENCE IN LASER-INDUCED GAS DISCHARGES
R. G. Tomlinson 15 Mar. 1965 14 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-2; AD-460460)

This report investigates the temporal dependence of laser-induced gas breakdown. A correlation is observed between the laser pulse amplitude and gas pressure and the time interval from the initial incidence of the pulse until a visible discharge occurs. This time interval can be so great that the visible discharge occurs when the intensity of the laser light in the focal region is only a fraction of what its peak intensity had been previously when no discharge occurred. These observations are consistent with the assumption that a small initial ionization (possibly caused by multiphoton absorption) grows to visible discharge densities in a cascade process involving electron-ion and electron-neutral molecule collisions in the presence of the laser field. Author

N65-21558# Raytheon Co., Waltham, Mass. Research Div.
INVESTIGATION OF CERTAIN BASIC PROBLEMS IN SOLID STATE AND GASEOUS OPTICAL MASERS Final Report, Dec. 1, 1963–Sep. 30, 1964
C. Tang Nov. 1964 134 p refs
(Contract AF 19(628)-3862)
(S-702; AFCRL-64-946; AD-612707)

This report gives results of an experimental and theoretical investigation of the spectral and transient characteristics of solid-state and semiconductor lasers and also a theoretical study of the nonlinear interaction of coherent lightwaves due to the higher order coherent Raman effects. It includes also a description of the detailed results obtained in a successful attempt at improving both the output spectra and the spiking characteristics of ruby and $CaWO_4:ND^{3+}$ lasers and some preliminary experimental results of higher order coherent Raman processes confirming that volume amplification of coherent lightwaves via the Raman processes have been observed. TAB

N65-22072# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
BREAKDOWN OF ARGON BY NEODYMIUM AND RUBY LASER PULSES
R. G. Tomlinson, E. K. Damon, and H. T. Buscher 28 Jan. 1965 9 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-1; AD-460459)

This report contains the first reported quantitative data on gas breakdown by radiation from a Q-switched neodymium laser. A comparison of the power densities required to produce breakdown in argon with a ruby laser pulse and with a neodymium laser pulse show larger breakdown power densities at the ruby frequency. The average breakdown densities at the two frequencies strongly indicate a frequency cubed relationship between the breakdown power density and the frequency of the laser radiation. Author

N65-22117# Joint Publications Research Service, Washington, D. C.
LASERS ARE OPERATIONAL NEW QUANTUM INSTRUMENTS SENT TO INTERNATIONAL FAIR AT LEIPZIG
V. Golovachev and V. Smirnov 29 Apr. 1965 6 p Transl. into ENGLISH from Pravda (Moscow), 9 Feb. 1965 p 4
(JPRS-29810; TT-65-30846) CFSTI: $1.00

A synopsis on Soviet development of quantum instruments is presented. Described is an optical quantum generator which can be used to locate objects in outer space, measure distances, and heat plasma to high temperatures. Also described are (1) the GOR-100 laser which can burn metallic plates; (2) the new Razdan laser that can sew a steel sheet; (3) the OK-1 ruby laser whose beam welds an exfoliated retina of the eye in one thousandth of a second; (4) the SU-1 apparatus which microwelds components invisible to the eye from refractory materials; and (5) the LUCH-3 miniature semiconductor instrument which measures less than the head of a pin (one tenth of a cubic millimeter). The representation of these instruments as models ready for serial production and not as laboratory models is stressed. S.C.W.

N65-22139# Rochester Univ., N. Y. Inst. of Optics
A STUDY OF THE EMISSION FROM A TRAVELING WAVE RUBY LASER
Claude B. Smoyer (M.S. Thesis) Nov. 1964 87 p refs
(Contract AF 19(628)-2360)
(AD-610865)

Theoretical predictions have indicated that spectral narrowing of the emission from a ruby laser should occur for a traveling wave laser cavity. Evidence of such spectral narrowing is presented. A comparison of equivalent traveling and standing wave cavities shows that for similar excitation, spectral narrowing of better than a factor of four can be achieved. However, multimoding in this experimental arrangement is still strongly evident. Results of preliminary experiments in "Q" switching the traveling wave cavity are also presented. These results are inconclusive, but do show the need for a more sophisticated experimental procedure for obtaining optimum results from a "Q" switched traveling wave laser cavity. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-21176# Southern Research Inst., Birmingham, Ala.
MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET
Quarterly Progress Report, Dec. 1, 1964–Mar. 1, 1965
Paul G. Adams and Clifford L. Dotson 19 Mar. 1965 34 p
(Contract N600(19)-59530)
(QPR-9; AD-612759)

The bend-transition temperature evaluations of the recrystallized and coated TZM molybdenum alloy sheet in the longitudinal and transverse directions were completed. Room-temperature compression evaluations of the 0.040-inch TZM sheet, and elevated-temperature unnotched tensile evaluations at 1200° and 2000° F were finished on the 0.016-, 0.020-, 0.040- and 0.060-inch TZM sheet as specified. The elevated-temperature compression properties were determined from different thicknesses of the tungsten sheet at selected temperatures. Additional notched and unnotched tensile evaluations on the 0.060-in. tungsten sheet, and on the 0.040-in. TZM sheet are underway. Results of the various evaluations are presented in tables. G.G.

N65-21204# Joint Publications Research Service, Washington, D. C.
FORMING AND FABRICATION OF TITANIUM
B. A. Galitskiy, M. M. Abelev, L. P. Kolosova, V. A. Toropov, and B. N. Shevelkin 18 Mar. 1965 106 p refs Transl. into ENGLISH of selected chapters from the book "Titan i Yego Splavy v Khimicheskom Mashinostr." Moscow, State Sci.-Tech. Publishing House of Mach.-Bldg. Lit., 1963 p 139–231
(JPRS-29181; TT-65-30539) CFSTI: $4.00

CONTENTS:
1. PRESSURE WORKING OF TITANIUM AND ITS ALLOYS B. A. Galitskiy p 1–51 (See N65-21205 11-17)
2. WELDING OF TITANIUM AND ITS ALLOYS B. A. Galitskiy p 52–101 (See N65-21206 11-17)

N65-21205 Joint Publications Research Service, Washington, D. C.
PRESSURE WORKING OF TITANIUM AND ITS ALLOYS
B. A. Galitskiy *In its* Forming and Fabrication of Titanium 18 Mar. 1965 p 1–51 (See N65-21204 11-17) CFSTI: $4.00

Pressure working of technically pure titanium and its low-content alloys is discussed, based on a large accumulation of factual information. Topics considered are features of pressure working, heating of blanks, bending of blanks made from rolled sheet iron, definition of the dimensions of the blanks, spring, bending on presses in stampings, bending of three- and four-roll sheet-bending machines, bending on machines with a turning bending beam, bending of pipes and of flanges, expansion of pipes, stamping of bottoms, flanging, press work, and forging and die forging. J.M.D.

N65-21206 Joint Publications Research Service, Washington, D. C.
WELDING OF TITANIUM AND ITS ALLOYS
B. A. Galitskiy *In its* Forming and Fabrication of Titanium 18 Mar. 1965 p 52–101 (See N65-21204 11-17) CFSTI: $4.00

Welding of titanium and its alloys is discussed, based on a large accumulation of factual information. Topics considered are argon-arc welding, automatic welding under a layer of flux, electroslag welding, contact welding, methods of control of welded connections, control of external defects by surface inspection, ultrasonic method of defect control, control of airtightness of seams using kerosene test, checking airtightness by helium and halogen leak detectors, and air pressure test of airtightness. J.M.D.

N65-21235# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE EFFECT OF TEMPERATURE AND FREQUENCY ON THE FATIGUE CRACK PROPAGATION IN 2024-T3 ALCLAD SHEET MATERIAL
J. Schijve and P. de Rijk Jan. 1965 40 p refs
(NLR-TR-M.2138)

Tests were carried out at 20° C and 2000 cpm, at 150° C and 2000 cpm, and at 150° C and 20 cpm. Three stress amplitudes and one mean stress were used. Results indicate a temperature effect as well as a frequency effect. Crack extension due to creep was considered, a few provisional results being presented. Results are analyzed, and compared with relevant data from the literature. Author

N65-21245# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EVALUATION OF THORIUM-BASE ALLOYS FOR HIGH-TEMPERATURE STRENGTH
J. A. Burka and J. P. Hammond Apr. 1965 28 p refs
(Contract W-7405-ENG-26)
(ORNL-3777) CFSTI: $2.00

An exploratory evaluation of the elevated-temperature properties of thorium-base alloys was made. Hot hardness and recrystallization temperature up to 750° C were used as screening tests to indicate the effectiveness of the alloying elements in strengthening thorium at high temperature. Zirconium and

indium showed the most promise as alloying additions. The Th–5 wt% Zr alloy was four times as hard as unalloyed thorium at 750° C and the Th–4 wt% In alloy five times. At 400° C the Th–0.2 wt% Be–0.2 wt% C alloy was about three times as hard as unalloyed thorium or about as hard as the indium-containing alloys. Zirconium and indium harden thorium principally by solid-solution strengthening with some contribution by intermetallic hardening in the case of indium. Author

N65-21259# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH STRENGTH STEEL
D. A. Prokoshkin 12 Jan. 1965 25 p refs Transl. into ENGLISH from Tr. Inst. Met., Akad. Nauk SSSR (Moscow), no. 13, 1963 p 108–121
(FTD-TT-64-679/1+2; AD-610350)

The technology of high-strength steels is discussed. Hardening with low annealing, cold plastic deformation, isothermal treatment, isothermal hardening, thermomechanical processing with deformation of supercooled austenite, thermomechanical treatment with hot plastic deformation, and thermomagnetic treatment are covered. Also, the mechanical properties of high-strength steels are tabulated for die steel, and cold-rolled stainless steel of the austenite class. Further, the mechanical properties of steel after thermomagnetic processing are reported. E.E.B.

N65-21261# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF HIGH-TEMPERATURE REFRACTORY METALS AND ALLOYS FOR THERMIONIC CONVERTERS Quarterly Progress Report
J. A. De Mastry and Griesenauer 10 Jan. 1965 19 p refs
(Contract AF 33(657)-10404)
(QPR-8; AD-455061)

Eleven refractory metals and alloys have been selected for corrosion studies in lithium (2500° to 3000° F) and cesium (2500° to 3400° F) and for compatibility studies with UN, UC, and UO_2 at 2500° to 3400° F. Rhenium is attacked by lithium after 100-hr exposure at 3100° F. The Mo–50Re and W–10Re alloy are not attacked. Rhenium, Mo–50Re, and W–10Re are compatible with cesium vapors for 100 hr at 3100° and 3400° F. Rhenium displays a reaction zone after 1000 hr of contact with lithium at 2500° F. The W–10Re alloy exhibits a slight surface attack under the same conditions. The Mo–50Re alloy is not attacked. Rhenium, Mo–50Re, and W–10Re are compatible with cesium vapor for 1000 hr at 2500° F. Attempts to bond yttria to tungsten and TZM were successful. Author

N65-21344*# Materials Research Lab., Inc., Richton Park, Ill.
ELEVATED TEMPERATURE STRESS CORROSION OF HIGH STRENGTH SHEET MATERIALS IN THE PRESENCE OF STRESS CONCENTRATORS First Interim Report
R. L. Kirchner and E. J. Ripling Nov. 1964 98 p refs
(Contract NASr-50)
(NASA-CR-57914) CFSTI: HC $3.00/MF $0.75

Under laboratory creep furnace conditions, AM 350 stainless steels, Inconel W, and V-36 were unaffected by 1000-hr exposures at 650° F and 60 ksi in the presence of sea salt. Salt coated samples of the titanium alloys, Ti–6Al–4V and Ti–8Al–1Mo–1V, however, were found susceptible to stress corrosion cracking at 650° F and 17.5 ksi under the same creep furnace exposures. The average time to failure for the latter was about 240 hr; although two specimens survived the 1000 hr while one failed after only 23 hr. At 600° F, practically no deterioration was found in the titanium alloys after 1000 hours of exposure. The severe sensitivity of titanium alloys to hot salt in laboratory tests is not consistent with its reported behavior in service. To predict whether or not titanium is safe in specific applications requires a better understanding of the mechanism of hot salt stress corrosion cracking. A tentative mechanism for hot dry salt stress corrosion is proposed. Author

N65-21384# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE "Ti-Al-Mo-Fe" SYSTEM OF ALLOYS [ISSLEDOVANIYE SPLAVOV SISTEMY Ti-Al-Mo-Fe]
A. I. Khorev and V. N. Moiseyev 13 Apr. 1965 10 p Transl. into ENGLISH from Tsvetn. Metal (Moscow), no. 1, 1965 p 84–89
(JPRS-29574; TT-65-30730) CFSTI: $1.00

The mechanical and technological properties of the Ti–Al–Mo–Fe system of alloys were investigated. Ingots with a constant aluminum content of 4% and variable molybdenum (2.5% to 3.5%) and iron (0.5% to 3.0%) content were smelted, transverse cold-rolled and worked to a thickness of 1.2-mm sheets. Metallographic examinations showed that an increased content of molybdenum and iron leads to lowering of the conversion-phase temperature of $(\alpha + \beta) \rightleftarrows \beta$, and the complete annealing of the alloys containing a larger percent of β-stabilizing elements occurs at lower temperatures. Mechanical tests of the samples immediately after the welding, after the annealing, and after their strengthening by heat treatment indicate that the plasticity of the metal of the seam is close to the plasticity of the basic metal of all alloys. An increase in iron and molybdenum content increases the strength of the welded joints in the thermally strengthened state. It was concluded that it is possible to select a Ti–Al–Mo–Fe composition with similar characteristics to the VT-14 alloy. G.G.

N65-21366# Joint Publications Research Service, Washington, D. C.
THE NATURE OF PLASTIC DEFORMATION IN TITANIUM ALLOYS UNDER DIFFERENT TYPES OF STRESS
L. P. Odinokova and I. N. Bogachev 16 Apr. 1965 12 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 2, Feb. 1965 p 71–77
(JPRS-29634; TT-65-30757) CFSTI: $1.00

Titanium VT-1, the α-phase of Ti-Al alloy in the annealed state, and the β-phase of Ti-Al-Co-Cr alloy in the chilled state were studied for their plastic deformation under complex conditions of loading. Coarse grain samples of 0.25 mm were used for metallographic analysis. The loads used were static and dynamic tension, and concentrated shock. The greatest plasticity was observed in titanium (δ up to 20%). Alloying of titanium with elements that stabilize both the α- and the β-phase reduced the plasticity, and all observed alloys possessed good strength and plastic properties. Dynamic stretching and deformation from concentrated shock of titanium resulted in slip, twinning, and displacement along boundary lines, depending upon the speed and form of the loading. G.G.

N65-21448*# Hanford Atomic Products Operation, Richland, Wash.
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS Quarterly Progress Report, Oct. 1, 1964–Jan. 1, 1965
1 Jan. 1965 21 p refs Sponsored by NASA
(Contract AT(45-1)-1350)
(NASA-CR-62109; HW-84550) CFSTI: HC $1.00/MF $0.50

Work on the recovery of technetium from fission product wastes continued with an impurity analysis of tungsten–technetium powders of various compositions. The mixtures were pressed isostatically in a rubber mold to form compacts and underwent arc melting after hydrogen sintering. All interior surfaces of the melt chamber were contaminated to a level of about 50 000 counts/min predominantly from the Tc^{99} beta activity. The alloys showed an initial decrease in hardness with a minimum at 2.5 to 3.5 at.% Tc, with further additions of technetium causing an increase in room temperature hardness. A change in the hardness curve at 30 to 40 at.% Tc represents the extent of solid solubility in the nonequilibrium cast structure. Hardness tests with alloys containing 5 at.% Tc or greater indicated twining deformation. No second phase inclusions were observed in as-hydrogen-reduced technetium powder. Metallographic examination of an electron beam melted pure technetium button showed a wide variation in grain size, no inclusions, but extensive twinning. Vacuum encapsulation of the melted button in a molybdenum container, with subsequent heating and processing, resulted in pure technetium that was only slightly tarnished. G.G.

N65-21450# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

POROSITY FORMATION AND SOLIDIFICATION PHENOMENA IN ALUMINUM WELDS

Z. P. Saperstein and D. D. Pollock [1964] 34 p refs Presented at the Marshall Space Flight Center Aluminum Welding Symp., Huntsville, Ala., 7–9 Jul. 1964

(Douglas Paper-3046)

Previous work clearly demonstrated that hydrogen is the greatest single cause of porosity in welds. It also indicated, in a qualitative way, that the final distribution of porosity in aluminum welds was determined by nucleation and growth kinetics. This work has been extended in an effort to obtain a quantitative description of porosity formation in terms of nucleation and growth rates. Analysis of porosity formation was undertaken using thermodynamic and classical nucleation and growth rate theories. These theories, when modified to account for unique weld metal solidification phenomenon, appear capable of describing the kinetics of porosity formation in aluminum welds. Author

N65-21455# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).

THE EFFECT OF HEAT TREATMENT ON THE PROPAGATION OF FATIGUE CRACKS IN LIGHT ALLOY SHEET MATERIAL

D. Broek, J. Schijve, and A. Nederveen May 1963 37 p refs (NLR-TR-M.2134; ICAF-297)

The effect was studied of artificial aging (up to and beyond maximum hardness, both with and without prior solution heat treatment) on the crack propagation in 2024-T3 alclad sheet. All heat treatments caused a noticeable increase of the rate of crack propagation, which was correlated with a decrease of ductility. The correlation is discussed, and relevant data from the literature are summarized. Some implications of the results for the curing cycle of adhesive bonding and for aerodynamic heating of structures are briefly indicated. Author

N65-21491# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center

REVIEW OF RECENT DEVELOPMENTS. MECHANICAL PROPERTIES OF METALS

J. E. Campbell 9 Apr. 1965 4 p refs

Low-temperature, high-temperature and fatigue properties and fracture testing methods are summarized for various alloys. The following are a few of the specific developments reviewed. Fatigue properties of sheet materials were evaluated at room temperature, at −320°, and at −432° F. Of the aluminum alloys, the 2014-T6 alloy had the highest failure stress at 10^8 cycles at −432° F, but had low notch and weld properties. Alloy 2219-T62 had the highest combination of failure stress and fatigue ratio for the welded aluminum specimens at −432° F. Of two titanium alloys, the Ti–6Al–4V had the best properties, but the ductility of the Ti–5Al–2.5Sn alloy appeared to be somewhat lower than expected for ELI grade. Methods of fracture toughness testing based on linear elastic fracture mechanics for the measurement by K_{Ic} values are summarized. These methods apply to high-strength steels, aluminum, and titanium alloys, and provide information which permits estimating the strength of structural elements containing cracks. E.E.B.

N65-21492# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center

REVIEW OF RECENT DEVELOPMENTS. NICKEL-BASE AND COBALT-BASE ALLOYS

D. A. Roberts 16 Apr. 1965 2 p refs

Recent developments in the field of nickel-base and cobalt-base alloys are summarized. Preliminary data on a low-carbon modification of 713LC, are given for composition, tensile strength, elongation, area reduction, 0.2% offset yield strength, and stress to produce rupture in 100 hours. Also, the commercial availability of a higher strength cast cobalt-base superalloy, 509, is announced. The nominal composition, tensile properties, and stress to produce rupture in 100 hours are given. Further, a modification to Co–25W–1Ti–1Zr–3Cr–2Rh–0.4C alloy is announced. The modified alloy has excellent formability and high-temperature strength comparable with the best cast cobalt-base alloys. The high-temperature mechanical properties of the alloy are presented. Because of the low chromium content, the alloy has a low evaporation rate in vacuum and should be suitable for space power applications. With a protective coating, it should be suitable for jet-engine components. E.E.B.

N65-21502# Naval Applied Science Lab., Brooklyn, N. Y. Material Sciences Div.

EFFECT OF PICKLING ON NOTCH-TOUGHNESS AND SURFACE PITTING OF HY-80/100 TYPE STEEL PLATE Progress Report

F. Ginsberg, I. Geld, I. A. Schwartz, and F. D'Oria 13 Jan. 1965 33 p refs

(PR-2; AD-609894)

Effects of acid pickling on HY-80/100 steel plate were investigated. Results indicated that pickling may be performed up to 2 hours without adverse effects, provided 48 hours of aging is observed before fabrication, and that for shorter aging intervals other precautions to minimize embrittlement must be observed. Severe windrowing is the result of mill rolling and not of pickling. Recommendations for modified pickling procedures are included. Author

N65-21521# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGHLY REFRACTORY METAL MATERIALS FOR ELECTROTHERMAL TECHNIQUE

Z. Ryska 19 Mar. 1965 12 p refs Transl. into ENGLISH from Electrotechn. Obzor (Czech.), v. 53, no. 1, 1964 p 22–25 (FTD-TT-64-999/1+2; AD-460498)

Applicability of metal oxides and their mixtures for high temperatures, as well as the need for their wider accessibility with regard to technology and costs are outlined. Besides an

analysis of the group of oxides Al, Mg, Ca, and Si, especially highly heat-resistant oxides of Zr, Be, Ti, Mo, and W, as well as some carbides, are considered. Their electrical, mechanical, and thermal properties are analyzed to facilitate the selection of the appropriate metal oxide for electrothermal purposes. Author

N65-21524# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING FATIGUE LIMITS BY TESTING ONE SAMPLE
V. Simek 24 Mar. 1965 17 p refs Transl. into ENGLISH from Strojirenstvi (Prague), v. 14, no. 3, 1964 p 216–222
(FTD-TT-64-1009/1+2; AD-460458)

Available methods of determining fatigue limits are too cumbersome, time consuming, and require a greater number of samples. The Locati method appears to be highly suitable since it enables evaluation of the material by testing one sample only. Results are described of experimentally verifying this simple method, and its precision is explained. The Locati method offers sufficiently reliable information for construction practice. Author

N65-21526# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Dept.
THE COMBINED EFFECTS OF TEMPERATURE AND IRRADIATION ON THE MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEELS
J. E. Irvin, A. L. Bement, and R. G. Hoagland Jan. 1965 24 p refs
(Contract AT(45-1)-1830)
(BNWL-1) CFSTI: $2.00

The effects of neutron irradiation and temperature on the mechanical properties of AISI 348 and 304 stainless steels have been determined using smooth and notched tensile specimens containing different amounts of cold work. Smooth tensile specimens were irradiated at about 50°, 290°, and 750° C. Room-temperature and 300° C tests on specimens in both the annealed and 25% cold-worked conditions show a marked reduction in ductility with increasing exposure and increasing test temperature. Damage accumulation as measured by changes in mechanical properties occurs more rapidly at the intermediate irradiation temperature. Control specimens exposed in an out-of-reactor loop at 282° C for times in excess of 5000 hr underwent a significant change in mechanical properties. A transition from notch strengthening to a notch-sensitive behavior was observed for specimens in the 20% and 40% cold-work levels after an exposure of about 1.0×10^{20} neutrons/cm^2. The effects of cold work, temperature, and chemical composition on the metallurgical stability of these materials were examined using magnetic measurements and X-ray diffraction. The magnetic susceptibility of both materials containing up to 70% cold work was determined before irradiation. No measurable change was noted in the magnetic susceptibility of either the annealed or 25% cold-worked materials. Optical and electron microscopy studies on both materials revealed no changes in structure due to the combined effects of irradiation and temperature. Author

N65-21530# Titanium Metals Corp. of America, New York.
THERMAL STABILITY OF ARC WELDS IN Ti-8Al-1Mo-1V TITANIUM ALLOY. CASE STUDY 9-2
D. R. Mitchell 17 Apr. 1964 22 p refs

The effects of elevated temperatures, both prior to and during loadings on the smooth and sharp notch tensile properties of welds, in Ti–8Al–1Mo–1V titanium alloy were determined. The following were among the observations made as a result of investigations. Unstressed welds in duplex annealed material showed only slight evidence of thermal instability after air exposure at temperatures of 500° to 700° F for periods up to 500 hours. The sharp notch tensile strengths of welds were almost always greater than the corresponding yield strengths of unnotched specimens. Welds in duplex annealed materials were as strong or stronger than the base metal at all test temperatures from ambient to 1000° F, and after exposure up to 500 hours at test temperatures to 800° F. Welds were weaker in single annealed material than the base metal at all test strengths to 800° F. The weld was slightly stronger than the base metal at 1000° F. There was no significant difference between welds made on 0.032 in.- and 0.060 in.-gage duplex annealed material. E.E.B.

N65-21561# Franklin Inst., Philadelphia, Pa.
PLASTIC DEFORMATION AND MARTENSITIC TRANSFORMATION IN IRON ALLOYS Final Report, Jan. 1963–Dec. 1964
John F. Breedis, Alan Lawley, and John D. Meakin Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1965 83 p refs
(Contract AF 33(657)-10205)
(F-B2052; AFML-TR-65-49; AD-612786)

An electron transmission study has been made of the martensite transformation in a series of stainless steels. The influence of chemical composition on martensite morphology has been investigated and the composition ranges which transform to lath, surface and plate martensite determined. Using polycrystalline samples of two compositions which transform to lath martensite, and investigation was conducted into the influence of prior plastic deformation and martensite formation. This is of course a contribution to the fundamental understanding of the ausforming process. A further investigation in this area was an examination of the transformation which occurs during plastic deformation at temperatures approaching the M_s. These experiments were performed on single crystals of the composition Fe-17Cr-16Ni. Finally, transmission studies were carried out to determine the processes occurring during reversion of an Fe-16Cr-12Ni alloy heated in the temperature range 500° to 900° C. Author

N65-21567# Battelle Memorial Inst., Columbus, Ohio.
STEELS FOR PIPING SYSTEMS WITH MAXIMUM PRESSURES OF 10,000 PSI, AND OPERATING BETWEEN −150° F AND +150° F
H. W. Mishler Redstone Arsenal, Ala., Redstone Sci. Inform. Center, 2 Nov. 1964 43 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-327; AD-459403)

The results are presented of a survey that was made to find commercially available steels applicable for use in welded high-pressure piping systems. The high-pressure piping systems operate at internal pressures of 3500 to 10 000 psi and at temperatures from −150° to +150° F. The steel must be capable of being welded with little or no preheat and should be satisfactory for service without a postwelding stress-relief treatment. Two steels, low-carbon 9% nickel and HY-80, will meet the requirements for this application. The low-carbon 9% nickel steel can be welded with no preheat. Weld joints in the as-welded condition have excellent low-temperature impact properties, good ductility, tensile strength of approximately 95 000 psi, and yield strength of approximately 60 000

psi. The HY-80 steel is welded with a 200° F maximum preheat, and it is possible to weld joints that have tensile strength of 130 000 psi and yield strength of 110 000 psi, good ductility, and good low-temperature impact strengths. Thick-walled seamless pipe made from the low-carbon 9%-nickel-steel pipe is commercially available. Author

N65-21574# Joint Publications Research Service, Washington, D. C.

JOINT PLASTIC DEFORMATION OF DISSIMILAR BODIES

G. E. Arkulis 21 Apr. 1965 278 p refs Transl. into ENGLISH of the book "Sovmestnaya Plasticheskaya Deformatsiya Raznykh Metallov" Moscow, Metallurgia 1964 p 1–271
(JPRS-29696; TT-65-30793) CFSTI: $6.00

Laws governing the joint plastic deformation of dissimilar metals treated by pressure are presented. Terms, concepts, and equations which are applicable for joint plastic deformation of dissimilar metals and which explain the effect of the number and properties of the components, dimensions of the body, coefficients of external and interlayer friction, and of the degree of compression on the distribution of deformations and stresses, deforming force, quantity of waste, tendency to distortion, and lamination are given. The results of experiments involving compression, drawing, and rolling in smooth and grooved rolls of bimetallic and homogeneous bodies are cited. Author

N65-21643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STUDIES OF TUNGSTEN COMPOSITES CONTAINING FIBERED OR REACTED ADDITIVES

Max Quatinetz, John W. Weeton, and Thomas P. Herbell Washington, NASA, Apr. 1965 36 p refs
(NASA-TN-D-2757) CFSTI: HC $2.00/MF $0.50

Twenty-one sintered tungsten and tungsten-plus-additive billets were prepared to evaluate the feasibility of producing fiber-bearing composites by the elongation of materials in situ (in a tungsten matrix) during extrusion, and to study reactions between the additives and the matrix with the objective of producing high-strength materials. Eight compounds, including oxides, borides, nitrides, and carbides, ranging in melting point from 4370° to 7030° F were successfully elongated in tungsten by extrusion at 4200° F. All composites with less than 10-volume-percent additive exhibited improvements in stress-rupture strength. Composites with highly elongated additives ranged from 4 to 18 times better in stress-rupture life at 3000° F than the unreinforced pure tungsten matrix. The stress-rupture lives of several composites with more reactive additives and only moderate fibering increased to 25 to 50 times that of tungsten at 3000° F. Because of inherent advantages, the in situ fibering method appears to have great potential for producing strong fibered composite materials and for producing fibers from strong, hard, and brittle refractory compounds and other relatively nondeformable materials. Author

N65-21704# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center

FIBER-REINFORCED METALS Review of Recent Developments

H. J. Wagner 11 Dec. 1964 2 p refs

Current research activity and some results are reported on fiber-reinforced metals. The topics are development of fiber-reinforced structural materials with unusually high strength, reinforcement of nickel-base alloys with alumina whiskers, factors affecting the wetting and bonding between metals and oxides, production of continuous lengths of glass-coated wire as small as 1 micron in diameter, metal-reinforced ceramics for making extrusion containers, and fiber strength in composites containing short alined fibers made from chopped drawn wire. J.M.D.

N65-21707# Hanford Atomic Products Operation, Richland, Wash.

CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Oct.–Dec. 1964

D. F. Carroll et al [1964] 88 p refs
(Contract AT(45-1)-1350)
(HW-81603) CFSTI: $3.00

Among the studies reported are the following: *Ceramic Fuel Research Studies*—the plutonium–boron system, beta plutonium sesquioxide, fast reactor UO_2-PuO_2 fuel, and formation of substoichiometric UO_2; *Irradiation Behavior of Ceramic Fuels*—plutonium ceramics irradiations and thoria irradiations; *PRTR Fuel Element Performance and Fabrication*—PRTR fuel element experience, postirradiation examination of failed PRTR fuel rods, and fuel clad corrosion; *Joint Fuel Development Programs*—Saxton plutonium fuel, pneumatic impaction of UO_2, and beryllium clad UO_2; *Development of Advanced Fuel Concepts*—wire enrichment, PuO_2–stainless steel cermets, UO_2–stainless steel cermet fuel fabrication, clad cermet technology, clad support by packed-particle fuels, and heterogeneous enrichment. G.G.

N65-21713# Carborundum Co., Niagara Falls, N. Y. Research and Development Div.

INTERSTITIAL DERIVATIVES OF β BORON

R. F. Giese, Jr., J. Economy, and V. I. Matkovich Feb. 1965 9 p refs Submitted for Publication
(Contract Nonr-4075(00))
(TR-7; AD-457613)

A new boron–silicon phase that is isotypic with β boron was prepared. The data indicate a composition of $B_{14}Si$. This new phase and a previously reported aluminum–boron phase are interpreted as interstitial derivatives of β boron. Author

N65-21739*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE TERNARY SYSTEM TANTALUM-HAFNIUM-CARBON AT 2050°C

Daniel L. Deadmore and Isidor Zaplatynsky Washington, NASA, Apr. 1965 15 p refs
(NASA-TN-D-2768) CFSTI: HC $1.00/MF $0.50

An isothermal cross section of the tantalum-hafnium-carbon system at 2050° C was constructed from X-ray diffraction, chemical analysis, metallographic, and microhardness data. No phases other than those appearing in the three binary systems were observed in the ternary system. A liquid phase was found in a large portion of the hafnium-rich corner of the ternary section. Author

N65-21747# General Electric Co., Schenectady, N. Y. Research Lab.

INVESTIGATION OF THE BASIC PARAMETERS AFFECTING THE PROPERTIES OF INTERMETALLIC COMPOUNDS Progress Report No. 1, Feb. 11–Jun. 11, 1964

J. H. Westbrook, A. U. Seybolt, and E. R. Stover Jun. 1964 32 p refs
(Contract AF 33(615)-1497)
(Rept.-64-GC-0281M; AD-460869)

Studies of sulfur-induced grain boundary hardening have shown conclusively by autoradiography that this effect is due

to grain boundary segregation; because of the parallel phenomenology the same basis is inferred for oxygen-induced hardening. The amount of solute necessary is extremely small, lying between 2% and 15% of the solubility limit, which itself may well be in the ppm range. Quenching temperature and quenching rate were demonstrated to have important effects on segregation-induced hardening through their effects on solute solubility and vacancy concentration in a manner consistent with a previously proposed model. Small additions of metallic solutes were found to exert effects on the processing and properties of NiAl. Additions of vanadium, titanium, and zirconium at approximately 0.05 to 0.1 at.% eliminate oxygen-induced grain boundary hardening under certain conditions. Other elements—in particular, zirconium, molybdenum, and rhenium—raise the recrystallization temperature by about 200° C. Author

N65-21768*# Battelle Memorial Inst., Columbus, Ohio.
THE DEVELOPMENT OF MAGNESIUM-LITHIUM ALLOYS FOR STRUCTURAL APPLICATIONS Final Technical Report
T. G. Byrer, E. L. White, and P. D. Frost 25 Jan. 1963 106 p refs
(Contract NAS8-5049)
(NASA-CR-62219) CFSTI: HC $4.00/MF $0.75

Exploratory studies were initiated on magnesium–lithium alloys LA141 and LA91 in the following areas: formability of sheet, extrusion of thin-wall tubing, machinability, chemical milling, deposition of metallic coatings, brazing, and corrosion behavior and protection. The capability of LA141 to be warm-formed into typical aerospace parts requiring simultaneous shrink and stretch operations was demonstrated. The LA141 alloy was found to have machinability, in lathe tests, comparable to that of 2024 aluminum alloy at low feed rates but much greater than the aluminum alloy at high feed rates. Limited experiments were conducted on electroplating of copper, nickel, and aluminum on LA141 alloy. Electroplating was found to be feasible for this alloy. Brazing experiments revealed that existing brazing filler metals for commercial magnesium alloys are not suitable for magnesium–lithium alloys because of incompatible melting ranges. A review of the literature on corrosion behavior and protection of magnesium–lithium alloys is given. Data sheets on surface treatments and coatings for commercial magnesium alloys are included. Author

N65-21777*# Kaiser Aluminum and Chemical Corp., Spokane, Wash. Dept. of Metallurgical Research
INVESTIGATION OF WELDING AND FABRICABILITY OF KAISER EXPERIMENTAL ALLOY MR39A Final Project Report, Jul. 1, 1962–Sep. 30, 1963
F. R. Baysinger 21 May 1964 178 p
(Contract NAS8-5065)
(NASA-CR-62233; MS-PR-64-12) CFSTI: HC $5.00/MF $1.00

The feasibility of the new Al alloys X7038 and 7039 for use in space and missile programs was investigated by (1) determination of mechanical properties at room temperature and −320° F of flat-position TIG weldments of alloys X7038-T6, X7038-T7, and 7039-T6; (2) stress corrosion tests of X7038-T6, X7038-T7, and 7039-T6 parent plate and weldments; and (3) weldability of the alloys by the MIG process in the flat position. Results showed that the best overall performance with weldments of these alloys was obtained with filler X5039 containing about 4% Mg and 3% Zn. Weldments of 7039-T6 made with this filler gave high tensile strength and excellent ductility, and were readily made under restraint with a minimum of weld cracking. The excellent properties of 7039 weldments were obtained with specimens containing nominal amounts of twinning, porosity, dross, incomplete penetration, and other defects. Detailed descriptions and data of the various tests and mechanical properties of the different alloys are included. G.G.

N65-21914# Western Gear Corp., Lynwood, Calif. Systems Management Div.
HIGH ENERGY RATE FORGING DEVELOPMENT, PHASE III Final Technical Progress Report, Oct. 1962–May 1963
L. C. Polley Apr. 1964 65 p *Its* Rept. No. 644-224
(Contract AF 33(600)-42523)
(AMC-TR-7-866(VI); AD-601722)

A manufacturing methods study was conducted to determine the possibility of forging unwrought tungsten and molybdenum alloy by the high energy rate forging (HERF) method. Successful HERF of unwrought refractory materials was found highly dependent upon the forging configuration and die design. Good forgings are possible when working stresses in the forged parts are compressive in nature. Tensile and shear stresses during forging generally result in fracturing of the billet if the refractory metals have received little or no plastic working prior to forging. Data for forging conditions and results of metallurgical examinations are presented. Author

N65-21924# Genoa Univ. (Italy). Inst. of General Chemistry
RESEARCH ON THE METHODS OF PREPARATION, THE CRYSTAL STRUCTURE AND THE GENERAL CHARACTERISTICS OF VARIOUS ALLOYS AND COMPOUNDS OF RARE EARTHS AND URANIUM, IN CONNECTION WITH THEIR USE IN THE MEASURING OF THERMOELECTRIC PROPERTIES [RICERCHE SUI METODI DI PREPARAZIONE, SULLA STRUTTURA CRISTALLINA E SULLE CARATTERISTICHE GENERALI DI DIVERSE LEGHE E COMPOSTI DELLE TERRE RARE ED URANIO IN RELAZIONE ALLA LORO UTILIZZAZIONE PER LA MISURA DI PROPRIETA TERMOELETTRICHE]
R. Ferro, R. Capelli, Marilisa Mattace-Raso, and Gabriella Rambaldi Brussels, EURATOM, Dec. 1964 12 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-023-61-12 ISPI)
(EUR-1894.i)

Alloys were prepared of uranium with germanium and of rare earths with Group VIII elements, especially rhodium, palladium, and platinum. The report gives the results obtained from determination of the crystal structures and in the course of other measurements, especially of magnetic susceptibility. It also contains observations recorded during the development of apparatus for measuring the thermoelectric efficiency. Author

N65-21948 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
NEUTRON IRRADIATION EFFECTS IN AUSTENITIC STAINLESS STEELS AND A NIMONIC ALLOY
G. H. Broomfield, D. R. Harries, and A. C. Roberts Nov. 1964 26 p refs
(AERE-R-4745)

The effects of neutron irradiation at ambient temperatures on the room and elevated temperature tensile properties of two austenitic steels (20% Cr; 25% Ni; Nb stabilized and A.I.S.I. Type 316) and a precipitation hardening nickel alloy (Nimonic PE16) were investigated. Neutron irradiation produces hardening and loss of ductility of all the alloys at test temperatures below about 500° C, the magnitudes of the effects increasing with increasing fission (or fast) neutron dose. Irradiation also reduces the elongation values at test temperatures above 650° to 700° C for the austenitic steels and at

600° C and above for the Nimonic PE16 alloy; the proof and ultimate strengths of the austenitic steels are not significantly affected but those of the Nimonic alloy are reduced after irradiation to high neutron doses. The elevated temperature tensile ductilities of the Nimonic alloy are affected to a much greater extent for a given neutron exposure than the 20% Cr; 25% Ni: Nb stabilized steel. Reductions in ductility at the elevated test temperatures are due primarily to the thermal (or slow) neutrons. Author

N65-21948 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
PRELIMINARY STUDIES OF DEFECT ANNEALING IN METALS BY MEASUREMENT OF ULTRASONIC ATTENUATION AT MEGACYCLE FREQUENCIES
T. S. Hutchison (Roy. Mil. Coll. of Can., Kingston, Ontario) Nov. 1964 31 p refs
(AERE-R-4759)

Measurements of ultrasonic attenuation at frequencies of 5 to 90 Mc/sec were used to detect pinning and depinning of dislocations. A technique of cold work and fast cooling to low temperatures is employed to place vacancies within the stress field of the dislocations. The temperatures at which interstitials become mobile over long range are then detected by their depinning effect on the vacancy pins and the resulting rise in attenuation. Gamma irradiation is used to produce homogeneous and simple defects in crystals of Al, Cu and Au at 77° K. The temperatures at which the interstitials become mobile over long range are 200° K in Al and 230° K in Cu and Au. Vacancies become mobile at 230° K, 285° K and 325° K in the three metals, respectively. There is evidence of an interstitial in Al with a low migration energy (≈ 0.1 eV) but no definite evidence in Cu and Au under the conditions of the experiment. Author

N65-21952 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
SURFACE TENSION BY PENDANT DROP TECHNIQUE
O. Flint Nov. 1964 26 p refs
(AERE-R-4782)

The electron bombardment–pendant drop technique for determination of values of surface tension of liquid metals is described, and the basic physical disadvantages are enumerated. The method is recommended only for reactive and high melting point metals and then only where other methods have proved inapplicable. Values of surface tension at the melting point for 14 materials are quoted. Author

N65-22011# Brown Univ., Providence, R. I. Div. of Engineering
INTEGRAL REPRESENTATION OF CREEP AND RATE SENSITIVITY IN METALS
E. T. Onat and T. T. Wang Mar. 1965 32 p refs
(Contract Nonr-562(20))
(TR-39; AD-460373)

It is shown that Frechet's integral representation of nonlinear memory dependent mechanical behavior may not be convenient for order-sensitive solids. Order-sensitive functionals may constitute a more convenient tool for the description of the mechanical behavior of such solids. Integral representations are constructed for order-sensitive functionals. Author

N65-22031# IIT Research Inst., Chicago, Ill. Dept. of Metallurgical Engineering
THE ANNEALING OF EXPLOSIVELY DEFORMED COPPER. I: THE PRE-SOFTENING STAGES
Paul Gordon, D. C. Brillhart (Argonne Natl. Lab.), and A. G. Preban (Inland Steel Co.) Jan. 1965 44 p refs
(Contract Nonr-1406(03))
(TR-13; AD-610859)

The OFHC copper explosively deformed at pressures between 75 and 435 kilobars is found characterized by high residual stresses, compressive near the surface and tensile further in. Annealing after such deformation is indicated to take place in three somewhat overlapping stages. Property changes associated with the first two stages, and possible interpretation of the effects, are discussed in detail. The third—major softening—stage is treated briefly as an introduction to a complete treatment to be given in a subsequent report. Author

N65-22059# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply
CORROSION OF ALUMINIUM
K. F. Lorking Sep. 1964 24 p refs
(ARL/MET-54)

As part of the proposed system for analysis of mechanisms of corrosion processes on aluminium, a technique for correlation of oxide film thickness with electrode potential on corroding aluminium is described. Results of oxide film thickness measurements are also used to give a more complete analysis of the mechanism of the effect of the chloride ion on corrosions of aluminium. Methods based on film thickness measurements and electrochemical measurements are proposed for the rapid assessment of the corrosive power of solutions towards aluminium. A series of standard measurements of corrosion weight losses, oxide film thickness determination and electrochemical measurements on pure aluminium have been obtained. Author

N65-22093# Menasco Mfg. Co., Burbank, Calif.
EVALUATION OF LOW EMBRITTLEMENT TITANIUM CADMIUM (DELTA) PLATING PROCESS AS PERFORMED BY THE MENASCO, BURBANK FACILITY
B. Gahnberg and J. Shelby 11 Jun. 1964 20 p
(A600)

Notched sustained load specimens of 4330M steel, heat treated to the 220 to 240-Ksi range and plated with titanium cadmium plate, withstood sustained load at a stress equal to 75% of the notched tensile strength for periods up to 700 hours, without failure. Notched 4340 steel specimens, heat treated to the 260 to 280-Ksi range and plated with titanium cadmium plate, withstood 700 hours of load without failure. Titanium cadmium plated salt-spray panels withstood more than 2600 hours of intermittent salt-spray exposure without any trace of corrosion products. Titanium cadmium (Delta) plating process shows no embrittling characteristics when applied to both 4330M at the 220 to 240-Ksi strength level, and 4340 at the 260 to 280-Ksi ultimate strength range. The corrosion resistance, as measured by salt-spray exposure, far exceeds that of any other conventional protective surface finish. Author

N65-22095# Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
EXTRUDING AND DRAWING MOLYBDENUM TO COMPLEX THIN H-SECTION Fifth Interim Technical Engineering Report, 15 Jul. 1964–15 Jan. 1965
P. A. Santoli Wright-Patterson AFB, Ohio, RTD, Jan. 1965 50 p refs
(Contract AF 33(657)-11203)
(RTD-TR-8-112(V); AD-611589)

Thirteen H-shaped extrusions of wrought arc-cast TZM were made using maximum possible billet length of nine inches. A completed extrusion was possible to 0.058–0.062-inch web thickness from 336° F billet temperature. This extrusion was also accomplished from 330° F with low carbon, wrought arc-cast TZM. As-extruded quality was good in surface finish and web dimensional run-out for twenty-foot lengths. However, considerable growth in fillet-radii occurred starting at a location of ten to twelve feet from the extrusion front-end. During extrusion, a failure in the tongue portion of pressed and sintered solid zirconia nib resulted in considerable damage to support tooling. However, several previous H-shaped TZM extrusions were accomplished in this program with excellent results using solid zirconia die nibs. Extrusion trials with plasma-sprayed zirconia indicated promising results. Author

N65-22097# Union Carbide Corp., Kokomo, Ind. Stellite Div.
PROPERTIES OF "HAYNES" ALLOY Cb-753 Developmental Report
M. Schussler 1 Mar. 1965 40 p refs

A new niobium-base alloy combining fabricability, weldability, and short-time strength properties was developed as a high-strength alloy to possibly replace niobium 1% zirconium, which has had extensive use in some nuclear reactor applications. Data on the properties of this alloy are summarized. The recrystallization temperature of cold-worked sheet and rod is about 2200° F. The microstructure consists of a matrix of niobium–vanadium–zirconium solid solution containing dispersed particles of ZrO_2 in two crystallographic forms. The alloy has excellent bend ductility, Olsen cup ductility, stress-rupture, and creep properties. Above 2000° F, the stress-rupture strength is not as attractive as that of niobium-base alloys containing tungsten. Also, the tensile properties appear quite attractive in the temperature range from room temperature to 2400° F. The alloy is metallurgically stable and weldments show good ductility at liquid nitrogen temperature. E.E.B.

N65-22128*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
GRAIN GROWTH CHARACTERISTICS OF VAPOR-DEPOSITED TUNGSTEN AT TEMPERATURES UP TO 2500° C
A. F. Weinberg, J. R. Lindgren, N. B. Elsner, and R. G. Mills 26 Mar. 1965 24 p refs Submitted for Publication
(Contract NAS3-4165)
(NASA-CR-62305; GA-6231) CFSTI: HC $1.00/MF $0.50

Tungsten prepared by vapor-deposition techniques is generally quite resistant to grain growth. Experimentation has shown that this resistance to grain growth is primarily related to a lack of driving force rather than to pinning of the grain boundaries by impurities; i.e., the material is deposited with a very highly oriented structure having low angle boundaries between the grains and is in a relatively stress free condition. In all cases where grain growth is observed, it is initiated at a layer of small, equiaxed, randomly oriented grains which extends into the deposited material up to 0.003 in. from the substrate surface. When growth has started in this layer, it then progresses, much like a wave front, through the remainder of the specimen. If this layer is removed prior to thermal treatment, resistance to grain growth is markedly improved. Author

N65-22154# Alfred Univ., N. Y. College of Ceramics
THE THERMAL-MECHANICAL BEHAVIOR OF STRONTIUM ZIRCONATE Bimonthly Progress Report, Dec. 1, 1964–Feb. 1, 1965
J. E. Funk, J. Nemeth, and J. R. Tinklepaugh [1965] 15 p refs
(Contract NOw-65-0131-o)
(BMPR-2; AD-611880)

Progress was made in the construction of the new stress-strain apparatus for high temperature research. The furnace has been calibrated showing a temperature gradient of about 7° C along a 2 inch bar. X-ray investigations of solid solutions to enhance yield and/or strength have continued. High temperature crystal symmetry studies of $SrZrO_3$ indicate no transformation up to 1250° C. Author

N65-22168*# Aero Vac Corp., Troy, N. Y.
EFFECT OF LOW DENSITY INERT GAS FLUSH ON OXYGEN–COLUMBIUM REACTION AT 1500° F TO 2000° F Quarterly Report
1 Dec. 1964 9 p
(Contract NASw-722)
(NASA-CR-62343) CFSTI: HC $1.00/MF $0.50

The detectability of impurities has been greatly extended; the sensitivity of the instrument, and maximum operating pressure, were both increased by one decade. These two factors, plus the reduction in background peaks due to ion–molecule interactions, increased the minimum detectable signal to approximately 20 parts per billion. It is felt that by purifying the gas to be analyzed to lower levels that are presently being obtained (100 to 1000 PPM), contaminants in the order of 1 to 10 PPB could be analyzed. The report discusses gas purification system analysis, present status, change over previous instrument, and potential improvements. Results to date with the gas analyses approach are summarized. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-21167# Massachusetts Univ., Amherst. Polymer Research Inst.
STRUCTURAL INTERPRETATIONS OF MECHANICAL PROPERTIES OF POLYCRYSTALLINE POLYMERS
Richard S. Stein 7 Aug. 1964 35 p refs
(Contract Nonr-3357(01))
(ONR-TR-66; AD-612488)

Two concepts of structure of crystalline polymers are reviewed and another model is proposed to unify existing knowledge of properties of crystalline polymers. Spherulitic crystallization is discussed in detail, including the topics of crystal growth, formation of lamella, size, birefringence, and crystalline material. Crystalline deformation under strain and temperature conditions is described. Birefringence and strain optical coefficient data are given on the effects of aging and rate of strain on polyethylene and several other polymers. It was concluded that the morphology of crystalline polymers may be affected by conditions of preparation, and that it greatly affects the mechanical response of the polymer. The arrangement of the crystals in spherulite aggregates and the interaction among these crystals influence their viscoelastic behavior. Evidence for the nature of the response of these crystalline aggregates may be obtained by optical techniques such as dynamic light scattering and X-ray diffraction. J.M.D.

N65-21189# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services
RESULTS OF INVESTIGATIONS ON THE CONTAMINATION OF OPTICAL GLASS BY FUNGI [ERGEBNISSE VON UNTERSUCHUNGEN UBER SCHADEN AN OPTISCHEN GLASERN DURCH PILZE]
G. Theden and W. Kerner-Gang Mar. 1965 12 p refs Transl. into ENGLISH from Glastech. Ber. (Frankfurt am Main), v. 4, no. 37, 1964 p 200–205
(TIL/T.5574)

Types of fungi causing damage, environmental conditions (humidity and nutrition) were considered and the nature of permanent damage was described. Test methods were developed for culturing and examining the contaminants. Relationship of degree of damage to type of glass was also studied. The use of tropical (T-) coatings was ineffective under existing conditions. Author

N65-21278# Boeing Co., Seattle, Wash.
STRENGTH EVALUATION OF CORNING 7940 FUSED SILICA GLASS
R. E. Horton [1964] 38 p refs
(Contract AF 33(615)-1624)
(D2-81286; AD-455327)

The purpose of this program was to determine the flexural strength and modulus of elasticity of Corning 7940 fused silica glass. The effect on strength of routing the glass with a 1/4 in. radius cutout was also evaluated. Flexural tests were conducted on 44 specimens at temperatures ranging from −320° to 2400° F. The maximum use temperature of the glass was established at 1800° F for the proposed Dyna Soar environment. Modulus of elasticity values were determined by a dynamic method from ambient temperature to approximately 2300° F. The elastic modulus showed an increase with increasing temperature. This correlated with previous dynamic modulus tests on this material. Three specimen configurations were evaluated to determine the stress concentration effect of edge cutouts. Results indicated that the stress concentration at the 1/4 in. radius was minimal and that this size radius was adequately large for design use. Author

N65-21426*# General Plastics Mfg. Co., Tacoma, Wash.
DEVELOPMENT OF LOW DENSITY RIGID POLYURETHANE FOAM FOR USE OF S-1C FLIGHT VEHICLES Final Report
Karl J. Eckman and Thomas S. Brazier 22 Oct. 1964 84 p
(Contract NAS8-11688)
(NASA-CR-62110) CFSTI: HC $3.00/MF $0.75

A low-density rigid polyurethane foam, designated R-4803.5, was developed that met the specific compression requirements, and was capable of being cast satisfactorily in a single pour. Another rigid polyurethane formulation, designated R-4603, of a density comparable to the first foam was developed which could be cast into a plastic exclusion riser closed mold. A mold and a sample part mold were forwarded for evaluation. Sixteen blocks measuring 24 × 60 × 72 in. were fabricated from formulation R-4803.5 and were completely X-rayed to determine the internal quality of the foam. Testing verified that all compression requirements were met. A systematic and reliable method for repairing damaged rigid polyurethane foam was developed, and reproducible results were satisfactory in meeting the strength requirements and dimensional tolerances. L.S.

N65-21520# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROPERTIES OF POROUS SINTERED-GLASS
Herbert Schoenborn 24 Mar. 1965 20 p refs Transl. into ENGLISH from Silikat Tech. (East Germany), v. 13, no. 12, 1962 p 419–424
(FTD-TT-64-992/1+2; AD-460453)

Expansion measurements were conducted on specimens made of fritted glass powder in order to explain the difficulties that are encountered in melting plates and forms made of porous sintered glass into glass instruments which were sintered at various temperatures and for various periods of time. The results indicated that noticable increases in expansion took place with a sudden expansion jump at a temperature of about 200° C, in connection with which the total elongation possesses a decided maximum at a sintering temperature that is dependent on the sintering time. At the same time, the growth speed of the cristobalite crystals that are precipitated in the glass, is determined. Both curves, the temperature dependence of the growth speed, and the temperature dependence of the increase in expansion that is caused by the sintering process, display excellent agreement in the curve pattern, so that the amount of the expansion increase of the frits can only be caused by the great speed in growth of the precipitated cristobalite crystals. Author

N65-21641*# Aeronutronic, Newport Beach, Calif.
STRENGTH CHARACTERISTICS OF COMPOSITE MATERIALS Annual Report, Jan. 1964–Jan. 1965
Stephen W. Tsai Washington, NASA, Apr. 1965 104 p refs
(Contract NAS7-215)
(NASA-CR-224) CFSTI: HC $4.00/MF $0.75

The strength characteristics of quasi-homogeneous, non-isotropic materials are derived from a generalized distortional work criterion. For unidirectional composites, the strength is governed by the axial, transverse, and shear strengths, and the angle-of-fiber orientation. The strength of a laminated composite consisting of layers of unidirectional composites depends on the strength, thickness, and orientation of each constituent layer and the temperature at which the laminate is cured. In the process of lamination, thermal and mechanical interactions are induced which affect the residual stress and the subsequent stress distribution under external load. A method of strength analysis of laminated composites is delineated using glass-epoxy composites as examples. The validity of the method is demonstrated by appropriate experiments. Commonly encountered material constants and coefficients for stress and strength analyses for glass-epoxy composites are listed. Author

N65-21705# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
THERMAL-PHYSICAL PARAMETERS OF MATERIALS Second Annual Progress Report, 21 May 1963–20 May 1964
R. E. Larson, A. R. Kydd, G. M. Rhodes, and R. A. Kuehnl 5 Aug. 1964 138 p refs
(Contract DA-19-129-QM-1998)
(ASD-2598; NLABS-TPMR-64-4; AD-457517)

Research on the thermal-physical parameters of materials necessary for protection against intense thermal radiation is reported. It summarizes results of theoretical studies and experimental investigations. The heat-flow equations for a fabric–airspace–skin system were solved using an explicit finite difference calculation procedure programed for the G-15D digital computer. Temperature responses of the fabric surfaces and skin surface were obtained for a constant radiant-heat input and for various values of the nondimensional radiation and convection heat-transfer coefficients. Implicit finite difference calculation procedures were studied and considered for use in solving the transient heat-flow equations in

the fabric–airspace–skin complex. A preliminary truncation error analysis was performed. Optical observations were made using the Mach–Zehnder interferometer in dual-path and single-path modes, allowing schlieren and shadowgraph viewing as well. Still and motion pictures were taken of the interference patterns during heating and eventual combustion of the fabrics. Author

N65-21856# United States Rubber Co., Wayne, N. J. Research and Development Dept.
BONDING CELLULOSE ESTERS TO ELASTOMERS Quarterly Progress Report, Oct.–Dec. 1964
C. H. Stiteler and D. I. Relyea 28 Jan. 1965 8 p Prepared for Allegany Ballistics Lab.
(QPR-4; AD-457866)

The incorporation of 2 parts of dimethylformamide or dimethyl sulfoxide per 100 parts of rubber slightly decreased the cure of ABL Spec. 123 rubber and decidedly decreased the MZP (N-4-carboxyphenyl)maleimide cure of HiSil-filled SBR. The cure of the latter could be improved by longer curing times. The stripping of nitrocellulose (NC) film from SBR stocks in an Instron machine gave erratic results. These pulls were made with an angle of approximately 90° between the NC film and rigidly backed piece of rubber. A more satisfactory method of testing NC adhesion to rubber is described. In this test, a pull in the Plastiversal machine is made perpendicular to the adhered surfaces. Pulls obtained in the Plastiversal test range from 113 psi to 233 psi. Additional work would be required to completely determine the effect of state of cure of the rubber, and wetting or softening agents on the adhesive bond. From a limited number of results it appears that the MZP cure of the liner stock leads to a stronger bond to nitrocellulose than does the sulfur cure. Attempts to prepare an adhesive agent containing both a maleimide and an isocyanate function were unsuccessful. Author

N65-22026# Goodyear Tire and Rubber Co., Akron, Ohio.
PROPELLANT ADHESIVES RESEARCH Third Quarterly Report, 12 Jul.–30 Sep. 1964
H. M. Rice 13 Nov. 1964 23 p Prepared for Hercules Powder Co.
(Rept.-19-407; AD-457803)

The study of fundamental factors pertaining to adhesives for bonding double-base propellants to substrates was continued. Based upon a small amount of data, it appears that Solvent D and possibly also three new experimental liquids have solvating powers similar to those of live casting solvent, and that case bond adhesion values usually increase as the adhesive layers' imbibing capacities for casting solvent increase. To explore these relationships further, samples of experimental soaking liquids and a second series of experimental adhesives were prepared for live propellant studies. For further description of the characteristics required in DBP adhesives, it was found that two known good adhesives form rubbery gels, comparable strengthwise to strong adhesive layers, when solvated by only 100% to 200% of experimental soaking liquids. Author

N65-22027# American Optical Co., Southbridge, Mass. Research Div.
PREPARATION OF PLATINUM-FREE LASER GLASS Semi-Annual Technical Report, 1 Aug.–31 Dec. 1964
W. R. Prindle, G. A. Granitsas, and C. G. Silverberg [1964] 37 p refs
(Contract Nonr-4656(00); ARPA Order 306-62)
(SATR-1; AD-457331)

Results are reported of a development program on an all-ceramic melting system for the production of a moderate amount of high quality, platinum-free, laser glass in a batch or semicontinuous manner utilizing high purity corrosion resistant ceramics, effective stirring, and some form of casting technique. Also reported are results of studies on the improvement of platinum for use in laser production without causing inclusions. Design specifications such as maximum absorption, glass composition, refractive index, absence of metallic inclusions, and absence of striae, are described. S.C.W.

N65-22176*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group
DEVELOPMENT OF IMPROVED HEAT STERILIZABLE POTTING COMPOUNDS Third Quarterly Report, 1 Jan.–31 Mar. 1964
Robert B. Feuchtbaum, Myra T. Willard, and Abraham L. Landis [1964] 50 p refs
(Contract NAS8-5499)
(NASA-CR-56443; P64-43) CFSTI: HC $2.00/MF $0.50

Infrared spectra of the prepolymers and their crosslinking agents have been taken from the materials which will be exposed to the low pressure thermal environment of the test vacuum train. Provisions have been made to trap and analyze by infrared spectroscopy any condensable gases or liquids emanating from the test specimens. The spectra of these materials will then be compared to the spectra of the starting materials, to determine the source of the condensible materials. A discovery made for use in the Phoenix missile and the AMCS for the F-111A. A mathematical equation was discovered which accurately predicts the thermal coefficient of expansion of a composite system from the coefficients of thermal expansion of the resin and the filler. The measurements which correlate with the calculated values were made at temperature below the Tg of the investigated materials. The use of this equation aids in the formulation of the low coefficient of thermal expansion materials. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-21168# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
STUDIES IN RESEARCH METHODOLOGY. VI: THE CENTRAL LIMIT EFFECT FOR A VARIETY OF POPULATIONS AND THE ROBUSTNESS OF Z, t, AND F
James V. Bradley Dec. 1964 300 p refs
(AMRL-TR-64-123; AD-612886)

The robustness of Z, t and F tests was studied by obtaining 1220 empirical sampling distributions each consisting of 10 000 values of the test statistic obtained under a unique combination of sampling conditions. Conditions investigated, both alone and in combination, were population shapes (nonnormal, normal, or some nonnormal and others normal), population variances (all σ^2, or some σ^2 and other $\sigma^2/4$), relative sample sizes (for two-sample tests N,N; 2N,N; 3N,N; or 2N,2N; for other multisample tests N,N,N; 2N,N,N; or N,N,N,N), and absolute sample size (N assumed values of 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, and in four special cases 2048 and 4096). Robustness at nominal significance levels of 0.05, 0.01, and 0.001 was examined for left-, right-, and two-tail

tests. The Central Limit effect upon means of samples from populations differing considerably in shape and degree of nonnormality was revealed in the robustness of certain Z statistics. Results showed that robustness varies drastically with conditions, and were iconoclastic with regard to general, unqualified, allegations of robustness. Author

N65-21406# Stanford Univ., Calif. Computer Science Dept.
COMPUTER SEARCH FOR NON-SOMORPHIC CONVEX POLYHEDRA
Donald W. Grace 29 Jan. 1965 144 p refs
(Contract Nonr-225(37))
(CS-15; AD-611366)

To classify the polyhedra, to survey the polyhedral-shapes, and to exhaust their variety by orderly enumeration is a naturally attractive problem, noticed by Euler and Jakob Steiner, to which some mathematicians, especially Max Bruckner, devoted considerable work. With the latest high-speed digital computers decades of manual labor can be compressed into hours. This dissertation is concerned with the solution of the enumeration problem on a digital computer. A tri-linear polyhedron is one in which each vertex is incident with exactly three edges. Two polyhedra are isomorphic if a one-to-one correspondence can be established between the vertices, edges, and faces of one with those of the other, so that the incidence relations between elements are preserved. Two polyhedra are called equi-surrounded if a one-to-one correspondence can be established between the faces of one and the faces of the other so that each pair of corresponding faces has equivalent surroundings—i.e. the neighbors of the two faces in question, when taken in cyclic order clockwise, display the same pattern of edge-counts. Isomorphism implies equisurroundedness. A counter-example with 18 faces disproves the converse. However, for polyhedra with up to 17 faces we can apparently equate isomorphism with equisurroundedness. TAB

N65-21484# California Univ., Berkeley. Operations Research Center
LINEAR CONTROL PROCESSES AND MATHEMATICAL PROGRAMMING
George B. Dantzig 9 Dec. 1964 10 p refs
(Grant NSF GP-2633)
(ORC-64-31(RR))

The application of mathematical programing and the decomposition principle in the form of the generalized linear program to linear control processes was studied. This approach obtains the general control for each cycle as a linear combination of exactly n+1 special controls obtained by minimizing for each t, the linear expression Min $(O_{t,\pi}u)$ in u for n+1 choices of π. Each new linear combination of these special controls will generate a new feasible control with a lower value for the total cost if the basic solution is nondegenerate. G.G.

N65-21507 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF DESCRIPTIVE GEOMETRY
V. A. Manevich [1964] 17 p refs Transl. into ENGLISH from Mathematical Collection (Moscow), v. 48(90), no. 1, 1959 p 105–116
(FTD-MT-63-300; AD-606750)

The one-to-one conformity between points of space and pairs of points on a plane, based on the properties of a linear complex and null system, is considered. Further, this conformity is the basis of the descriptive geometry method presented. The measurement of sections and the perpendicularity of a line to a plane are developed. Also, the theorem that two collinear fields, the line of intersection of which is self-convergent, determine linear congruency is obtained. E.E.B.

N65-21514# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF REPRODUCING A HOMOGENEOUS FUNCTION OF TWO VARIABLES
I. V. Dem'yanchuk 17 Jun. 1963 4 p Transl. into ENGLISH from Russian Patent No. 145020 (Appl. no. 687642/26), 3 Dec. 1960 p 1–2
(FTD-TT-63-502/1+2; AD-413594)

A method of reproducing a homogeneous function of two variables (x and y) through introduction of functions of an auxiliary argument xi = y/x is discussed. The function is approximated in the form of an exponential binomial with the coefficients at variables remaining constant in a certain range of values and changing during transition from section to section. G.G.

N65-21623# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
ON THE CONVERGENCE PROPERTIES OF THE METHOD OF GRADIENTS—AND THE SINGULAR CASE
Donald E. Johansen [1964] 66 p refs Presented at the Joint AIAA-IMS-SIAM-ONR Symp. on Control and Optimization, Monterey, Calif., Jan. 1964
(RR-384)

The rate of convergence that can be expected when applying the method of gradients to solve optimal programing problems in the calculus of variations is investigated. The convergence properties of the method using a large amplitude theory for deviations of control from the optimal solution are qualitative in nature; convergence properties using an asymptotic theory valid for small deviations in control are quantitative and lead to precise statements concerning asymptotic rates of convergence. A direct relationship between rate of convergence and singularity of the second variation operator is discovered for the problem: When the operator has no small eigenvalues asymptotic rate of convergence is rapid. When one or more of its eigenvalues are small asymptotic rate of convergence is slow. The point in the calculations where slow convergence sets in depends on the number and density of eigenvalues for the second variation operator that lie in the vicinity of zero. The presence of a large number of small eigenvalues can be expected to cause onset of slow convergence to occur very early, perhaps in the first several iterations of the numerical solution. E.E.B.

N65-21740*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
STABILITY OF MULTISTEP METHODS IN NUMERICAL INTEGRATION
Robert N. Lea Washington, NASA, Apr. 1965 18 p refs
(NASA-TN-D-2772) CFSTI: HC $1.00/MF $0.50

One widely used technique for the numerical solution of a differential equation is to approximate the differential equation by a difference equation, and then to solve this difference equation. This paper treats the stability of the solutions obtained by this method. An original development leading to a definition of stability shows a relation between stability and certain properties of the systems of differential equations to be solved. Previous investigations (with the exception of Dahlquist's work) have shown a similar relation, but were limited to the consideration of a single equation. Dahlquist's theory, while valid for systems of equations, shows no such relation. Author

N65-21778*# Maryland Univ., College Park. Computer Science Center
ON A GENERAL ESTIMATION PRINCIPLE AND A THEORY OF COMPARISON-FACTORS
Werner C. Rheinboldt Feb. 1965 43 p refs
(Grants NsG-398; D-31-124-G563)
(NASA-CR-62262; TR-65-14) CFSTI: HC $2.00/MF $0.50

The idea, introduced by Aumann, of the comparison-factor in approximation problems is generalized to assume the form of a general estimation principle for nonnegatively homogeneous real functions on linear spaces. A number of results are then proved concerning the finiteness of the correspondingly generalized comparison-factor. In addition, transformations of the underlying spaces are investigated which preserve the finiteness of these factors. The results are then applied to the special case of finite dimensional linear spaces and to a particular case which provides a connection to earlier results of other authors on best error bounds for optimal linear approximations. Author

N65-21913# Sperry Gyroscope Co., Ltd., Brentford (England). Engineering Dept.
THE DERIVATIONS OF THE Z TRANSFORM FOR PARTICULAR TIME FUNCTIONS
A. Mc Donald Dec. 1964 11 p refs
(TN-787)

The Z transform was derived for particular time functions using techniques similar to those used in the derivation of jump functions. Laplace transform variable and finite time are also calculated. S.C.W.

N65-21964# Stanford Univ., Calif. Dept. of Statistics
DEVELOPMENT AND EVALUATION OF PROCEDURES FOR QUANTIZING MULTIVARIATE DISTRIBUTIONS
Paul Zador 10 Dec. 1963 66 p refs
(Contract Nonr-225(52))
(TR-92; AD-426677)

An approximation method in which a K-dimensional continuous random variable is replaced by a discrete value is presented. In the basic discrete-quantizing model, the continuous variable, X, is a point in Euclidean K-space with probability distribution p(X); the K-space is partitioned into N nonintersecting sets, and in each of them a single point is chosen so that every X-value in that set is represented by that point. However, in the final form of the method, the N representation points are selected randomly and independently, according to an arbitrary distribution, and each X-value in the K-space is replaced by its nearest representation point. Quality of approximation is measured in the usual sense of statistical error, based on moments of the difference between approximate and exact values. Theorems are proved on the behavior of the lower bound of the average normalized error for fixed N and p(X), when N is large, and when entropy rate of the approximating sequence is taken into account. Application to information theory and psychological testing are discussed. J.M.D.

N65-22092# California Univ., Berkeley. Operations Research Center
OPTIMIZATION BY PRICE COMMUNICATION BETWEEN LEONTIEF ECONOMIES
Paul Rech Dec. 1964 20 p refs
(Grant NSF GP-2633)
(ORC-64-35)

A decomposition algorithm for solving the following type of problem is presented, along with all of its justifications.

$$\text{Minimize} \quad Z = c_1x_1 + d_1Y_1 + d_2Y_2 + c_2x_2$$

$$\text{subject to} \quad \begin{aligned} A_1X_1 + IY_1 - IY_2 &= b_1 \\ -IY_1 + IY_2 + A_2X_2 &= b_2 \\ X_1 \geq 0, Y_1 \geq 0, Y_2 \geq 0, X_2 &\geq 0 \end{aligned}$$

where A_1 and A_2 are Leontief matrices with substitution. The method generalizes to any number of Leontief economies with substitution. The method consists essentially of a symmetrical decomposition of the problem into two subproblems which are solved alternatively, in such a way that the only required exchange of information between the two is knowledge of each others' proposed prices. The optimal program itself requires alternative exchanges of one set of proposed simplex multipliers (prices) and one set of activity levels Y. Author

N65-22105# RAND Corp., Santa Monica, Calif.
ALGEBRAIC TECHNIQUES AND THE MECHANIZATION OF NUMBER THEORY
Stephen A. Cook Mar. 1965 38 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4319-PR; AD-612267)

A number of mechanical procedures for generating proofs of theorems of logic have appeared in the literature, all based on the Skolem-Herbrand theorem. Although in principle the procedures can be applied to find proofs of mathematical theorems, the procedures are very inefficient for this purpose because they are designed to operate on too large a domain. This report outlines a general method by which these procedures can be adapted to operate more efficiently on a much more restricted domain: the statements of elementary number theory. The method is given a theoretical justification, and several specific algorithms are described for realizing the general method. These algorithms are applied to examples. Much more detailed study must be done before the method can be successfully utilized by a computer to generate proofs of difficult number-theoretic theorems. Author

N65-22132*# Florida Univ., Gainesville.
STUDIES IN PERTURBATION THEORY. X: LOWER BOUNDS TO ENERGY EIGENVALUES IN PERTURBATION THEORY
Per-Olov Lowdin (Uppsala Univ.) 1 Jun. 1964 59 p refs *Its* Preprint-64
(Grant NsG-512)
(NASA-CR-62299; TN-120) CFSTI: HC $3.00/MF $0.50

The eigenvalue problem $H\psi = E\psi$ in quantum theory is studied by the partitioning technique. It is shown that, if E is a real variable, a function $E_1 = f(E)$ may be constructed such that each pair E and E_1 always bracket at least one true eigenvalue E. If E is chosen as an upper bound by means of, e.g., the variation principle, the function E_1 will provide a lower bound. The reaction operator t associated with the perturbation problem $H = H_0 + V$ for positive definite perturbation V is studied; it is shown that a lower bound to t may be constructed in a finite number of operations by using inner projection. By means of truncated basic sets not only upper bounds but also useful lower bounds, can be obtained which converge towards the correct eigenvalues when the set becomes complete. The method is applied to the Brillouin-type perturbation theory; applications to Schrödinger's perturbation theory are also outlined. The method is numerically illustrated by a study of lower bounds to the ground state energies of the helium-like ions: He, Li^+, B^{+2}, etc. Author

N65-22150# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics
STABILITY AND ASYMPTOTIC FIXED POINT THEORY
G. Stephen Jones Feb. 1965 15 p refs
(Contract Nonr-595(17))
(BN-387; AD-611405)

An asymptotic fixed point theorem is developed as a generalization of the Schauder fixed point theorem which states: If S is a closed convex subset of a Banach space X, every continuous compact mapping of S into itself has a fixed point. When it is difficult or impossible to identify a set S with appropriate properties and such that T(S) is a subset of S and when the functional equation exhibits strong asymptotic or stability properties as the independent variable becomes very large, then the asymptotic fixed point theory is needed. TAB

N65-22164*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
PERTURBED OPERATORS IN HILBERT SPACE
Theodore W. Palmer 25 Sep. 1964 46 p refs
(Grant NsG-275-62)
(NASA-CR-62356; WIS-TCI-62) CFSTI: HC $2.00/MF $0.50

This report reviews the theory of perturbed operators in an abstract Hilbert space and some important applications of the theory to quantum chemistry. It is intended to serve as an introduction to the original papers of Rellich, Sz-Nagy, Kato and others. The theory developed by these authors rigorously justifies the use of Rayleigh–Schrodinger perturbation theory in many important quantum chemistry problems. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-21201# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON METEOROLOGY AND CLIMATOLOGY [LITERATUUROVERZICHT, METEOROLOGIE EN KLIMATOLOGIE]
16 Jan. 1965 24 p refs In DUTCH *Its* 11th Yearly Issue, No. M-122

Abstracts on meteorology and climatology are presented. Among the subjects covered are: (1) synoptic and upper air observations in the Netherlands; (2) meteorological parameters in the Netherlands during 1962; (3) bivane and sonic techniques for measuring the vertical wind component; (4) Tiros 8 picture transmission; (5) computer system selection for meteorological operations; (6) static stability variation in two-layer quasi-geostrophic models; (7) vertical structure of the atmosphere; (8) tropospheric diabatic heating and the generation of available potential energy; (9) energetics of the mean and eddy circulations in the lower stratosphere; (10) seasonal persistence and recurrence of European blocking during 1958–1960; (11) model of the 26-month oscillation in tropical latitudes; (12) winds; (13) cloud structure and distributions; and (14) atmospheric turbulence. E.E.B.

N65-21231*# National Aeronautics and Space Administration, Washington, D. C.
DETECTION OF NEAR ATMOSPHERIC DISTURBANCES AND WEATHER CONDITIONS [PELENGOVANIYE BLIZHNIKH ATMOSFERIKOV I POGODNYYE USLOVIYA]
I. I. Kamaldina Apr. 1965 7 p Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 70–72
(NASA-TT-F-331) CFSTI: HC $1.00/MF $0.50

The article considers the relationship of the detection of near storms and meteorological data. Author

N65-21271# France. Direction de la Meteorologie Nationale, Paris. Centre Meteorologique Principal d'Orly
AERONAUTICAL CLIMATOLOGY AT ORLY AIRPORT (1949–1958) [CLIMATOLOGIE AERONAUTIQUE DE L'AEROPORT D'ORLY (1949–1958)]
Pierre Duverge and J. G. Gassies Jan. 1965 177 p In FRENCH *Its* Monograph No. 45

This work is comprised of statistics based on 10 years of observations (1949 to 1958). The first part presents a history of the observation station at Orly, its installations and equipment, and an analysis of the statistical methods used. The second part presents the climatological data proper. Tables and graphs establish relationships between monthly and hourly synoptic data and values observed for visibility and ceiling, fog conditions as a function of wind, monthly and annual wind speed, seasonal distribution of occurrences of low celing and/or low visibility, temperature and pressure distributions, schematics of meteorological conditions, and the number of days of fog, precipitation, snow, hail, storm, freezing, and icing. M.P.G.

N65-21304*# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.57 GG (S/N NASA 143) Meteorological Data Report
Marjorie Mc Lardie Hoidale Apr. 1965 45 p refs
(NASA-CR-57831; ERDA-297) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Aerobee NASA 4.57 GG (S/N NASA 143) are presented along with calculated ballistic data. Author

N65-21307*# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.56 GG (S/N NASA 133)
Marjorie Mc Lardie Hoidale Mar. 1965 43 p refs
(NASA-CR-57825; ERDA-294) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Aerobee NASA 4.56 GG (S/N NASA 133) are given, along with calculated ballistic data. Author

N65-21311*# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.63 GS (S/N NASA 133) (17 MARCH 1965) Meteorological Data Report
Marjorie Mc Lardie Hoidale Apr. 1965 45 p refs Sponsored by NASA
(NASA-CR-57804; ERDA-295)

Meteorological data gathered for the launching of Aerobee NASA 4.63 GS (S/N NASA 133) are presented for ballistic studies, along with calculated ballistic data. Author

N65-21392*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
EVALUATION OF TIROS INFRARED DATA
C. Prabhakara (New York Univ.) and S. L. Rasool Sep. 1962 29 p refs Presented at the Intern. Symp. on Rocket and Satellite Meteorology, Washington, D.C., 23–25 Aug. 1962
(NASA-TM-X-55178; X-644-62-77) CFSTI: HC $2.00/MF $0.50

Tiros II measurements of the outgoing infrared radiation at nadir angle 25° were used to obtain the latitudinal distribution of the total outgoing radiation for each longitude grid between 50° N and 50° S. Comparison with a model atmosphere constructed for the months of December 1960 and January 1961, and using the parameters of temperature, carbon dioxide, ozone, water vapor, clouds, and the absorption coefficients, showed good agreement. Tiros II measurements of the radiation escaping in the 7μ to 13μ region to estimate the ground temperature showed a discrepancy of several degrees with the actual ground temperature due to the water vapor continuum in the 7μ to 13μ region. Computations of the outward going flux from a corresponding model atmosphere for clear and a partially cloudy atmosphere and comparison with the data from the 7μ to 13μ region sensor showed some discrepancy assumed to be caused by the sensor calibration or the difference between the assumed and the actual cloud cover. G.G.

N65-21421*# RAND Corp., Santa Monica, Calif.
AN EXAMINATION OF THE APPLICATION TO SATELLITE METEOROLOGY OF VARIOUS SEGMENTS OF THE ELECTROMAGNETIC SPECTRUM. PART 2: METEOROLOGICAL SATELLITE OBSERVATION OF THERMAL EMISSION
W. W. Kellogg, K. J. K. Buettner (Washington Univ. Seattle), and E. C. May (Pittsburgh Univ.) Dec. 1964 110 p refs
(Contract NASr-21)
(NASA-CR-60483; RM-4392-NASA) CFSTI: HC $4.00/MF $0.75

The physical principles of thermal radiation emission and transmission, including Planck's law, emission of real surfaces, gas absorption, and scattering by clouds and haze, are discussed. Also, the potential applications of infrared and microwave measurements to the heat budget of the atmosphere, heat balance determination, temperature distribution in the atmosphere, surface conditions, and effective temperatures are presented. The possibilities of using satellites in these type measurements are emphasized. At present, observations from balloons and rockets give data on the temperature structure of the atmosphere at a few points on the earth. With improved instrumentation and data evaluation techniques, spectral scanning may yield the temperature of the stratosphere over the entire globe, from above the cloud tops to 30 km or higher. E.E.B.

N65-21516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD AND APPARATUS FOR STUDYING BOUNDARY LAYER OF THE ATMOSPHERE FROM SHIPS
I. V. Vasil'chenko, P. A. Vorontsov et al 13 Jun. 1963 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 135, 1962 p 120–128
(FTD-TT-63-533/1+2; AD-411182)

A method is discussed of investigating the lower layer of the atmosphere over 1.5- to 2-km water reservoir from ships with the aid of helicopters and aerostats, and also an apparatus applicable for sounding. The disposition and exploitation of helicopter and aerostat on board ships are described. The mode of operation of the equipment used under sea conditions is explained, and recommendations are given for further investigation of the driven layer of the atmosphere. Author

N65-21517# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROBAROGRAPH FOR THE REGISTRATION OF VERY SMALL FLUCTUATIONS OF ATMOSPHERIC PRESSURE CAUSED BY THE PASSAGE OF INTERNAL WAVES
A. A. Gusikov 17 Jun. 1963 6 p refs Transl. into ENGLISH from Tr. Morskogo Gidrofiz. Inst., Izd. Akad. Nauk SSSR (Moscow), v. 23, 1961 p 148–150
(FTD-TT-63-541/1+2; AD-413601)

A microbarograph for recording microfluctuations of atmospheric pressure in a broad range of periods is described. Laboratory tests based on wire-type resistance sensors demonstrated the high sensitivity of the instrument and its possible application to the study of atmospheric internal waves. The instrument can also be used in marine technology for recording vertical rocking of a vessel and registration of surface waves with the aid of flotation devices. S.C.W.

N65-21759*# Travelers Research Center, Inc., Hartford, Conn.
PRELIMINARY ESTIMATES OF ENVIRONMENTAL EXPOSURE FOR FUEL AND EXHAUST PRODUCTS, VOLUME I. PART I: METHODS AND PRELIMINARY ESTIMATES FOR MSFC. PART 2: RECOMMENDED EXPERIMENTAL DESIGN FOR MSFC
Keith D. Hage and Norman E. Bowne Jan. 1965 157 p refs
(Contract NAS8-11450)
(NASA-CR-62258) CFSTI: HC $5.00/MF $1.00

Estimates of gas and vapor concentrations and exposure times in the vicinity of an operational site at distances up to several miles are considered because of proposals for operational use of fuels with relatively high toxicity levels. Examined in detail are some of the meteorological aspects of the safety problem. A simple mathematical model of cloud formation and growth was formulated and solved for selected initial and boundary conditions in a preliminary attempt to identify and simulate the essential physical processes. The transport and spread of the vapor cloud was divided into two phases, a heated source and a cold source. The concentration distribution and spatial dimensions of the cloud under quasi-ambient conditions of pressure and temperature were used as initial conditions for the second phase in which further cloud growth was controlled by eddy diffusion with and without deposition at the lower boundary. A thorough mathematical analysis of the statistical diffusion model was prepared to ensure that the sampling density would be satisfactory but not excessive. R.W.H.

N65-21805# Joint Publications Research Service, Washington, D. C.
OBJECTIVE ANALYSIS IN METEOROLOGICAL STUDIES
20 Apr. 1965 43 p refs Transl. into ENGLISH from Tr. Mirovogo Meteorol. Tsentra, no. 4, 1964 p 3–26, 44–49
(JPRS-29671; TT-65-30777) CFSTI: $2.00

This article presents a method for objective (machine) analysis of aerological data over the northern hemisphere. The computation method is used with a high-speed electronic computer. There is an analysis of AT850, AT500, and AT300 charts. The results indicate the possibility of using the proposed method for the purpose of numerical forecasting. Author

N65-21876# Congress. House. Committee on Government Operations.
GOVERNMENT WEATHER PROGRAMS (MILITARY AND CIVILIAN OPERATIONS AND RESEARCH)
William L. Dawson Washington, GPO, 1965 212 p First Report of Comm. on Govt. Operations, 89th Congr., 1st Sess., Union Calendar No. 70, House Rept. No. 177

A systematic account of various U.S. and international weather programs, conducted by several Government agencies, is presented. The following aspects of existing weather programs are covered: (1) a breakdown of weather operations, activities, and research by agency, including the legislative history, a description of programs, and a summary of resources and funds used to execute them; (2) interagency coordination efforts; (3) international aspects of weather programs; and (4) comments, suggestions, and recommendations for further action. Emphasis is placed on weather services, and the research and development supporting such services. G.G.

N65-21890# Emmanuel Coll., Boston, Mass. Research Language Center
DISPERSAL OF FOGS BY ELECTRICITY [LE BALAYAGE ELECTRIQUE DES BROUILLARDS]
Marcel Pauthenier and Nadi Loutfoullah Bedford, Mass., AFCRL, Nov. 1964 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 231, 1950 p 953–956
(Contract AF 19(628)-3869)
(E-T-R-64-12; AD-457323)

The possibility of electrical condensation of atmospheric mists (clouds or fogs) was shown by an approximation calculation, and initial experiments in a fog tower have confirmed the results predicted by the calculation. A complete calculation of electrical dispersal produced by an electrified spherical particle O (charge q_o, radius R, specific mass μ) falling vertically in a neutral fog of particles such that P (radius r appreciably smaller than R, specific mass ω) was accomplished. It was assumed that the height of the fall was quite small in order to neglect the increase in size of the electrified particle by annexation of neutral particles. It was shown that there is a collision if the initial distance P from the vertical XX' is less than a distance

$$d = \left[\frac{4^5}{16g} \frac{Qo^2}{\mu \frac{R^2}{r^2} \omega} \right]^{\frac{1}{4}}$$

Numerical comparison shows electrical capture is unfavorable since, because of fluid mechanics behavior, the geometric dispersal caused by neutral spherules of 15^{μ} radius is negligible. A coefficient of capture approaching unity is attained only for $R > 100^{\mu}$, which would require seeding with neuter droplets totaling 130 tons of water per square kilometer. For heavy fog layers, and eventually for clouds, account must be taken of the increase in R during the fall. R.W.H.

N65-22048# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology
SUMMARY OF AUTOMATED ENVIRONMENTAL DATA COLLECTED OFF PANAMA CITY, FLORIDA, JUNE 1962–DECEMBER 1964
A. Kirst, Jr. and R. D. Gaul 31 Dec. 1964 59 p refs
(Contract Nonr-2119(4))
(AD-611210)

The data acquisition and telemetry equipment is on two fixed platforms which are 11 and 1.6 nautical miles offshore. The system is designed to simultaneously serve two major functions. One is the semicontinuous acquisition of "background" environmental information, the second is the continuous or semicontinuous acquisition of data prescribed for individual studies or experiments. Brief descriptions of system arrangement, functions, engineering characteristics and data handling procedures insofar as they are pertinent to general evaluations and use of the data system generates are given. A tabulation of the parameters time periods of collection for data taken between June 1962 and October 1964 is included. These data are available for processing. TAB

N65-22054# National Aeronautical Lab., Bangalore (India).
A STUDY OF THE HOURLY WIND SPEEDS AT JAGDALPUR AND JAMSHEDPUR FROM THE POINT OF VIEW OF WIND POWER UTILIZATION
D. V. L. N. Rao, K. N. Narasimhaswamy, and S. R. Radhakrishnan Jan. 1964 26 p ref
(TN-WP-34-64)

The analysis of hourly wind speeds for Jagdalpur and Jamshedpur revealed certain features of wind power utilization, which called for a combined study of these two stations. One of these factors is the low value of annual energy at each of these stations compared to the other stations. Jagdalpur has an annual mean wind speed as low as 3 km per hour. The annual output of energy from a windmill of 30-sq m swept area, cut-in speed of 8 km per hour and constant overall power coefficient of 12% works out to 89 kWh. The quantity of water that can be pumped in a year by a WP-2 type windmill of 23.6-sq m swept area and overall power coefficient of 12% has been estimated at 2600 kl. Jamshedpur has an annual mean wind speed of 5 km per hour. The annual output of energy here works out to 236 kWh. The quantity of water that can be pumped by a WP-2 type windmill at Jamshedpur has been estimated at 6580 kl per year. Author

N65-22080# Travelers Research Center, Inc., Hartford, Conn.
A PHYSICAL MODEL FOR THE PREDICTION OF LARGE-SCALE LOW CLOUDINESS
Joseph P. Gerrity, Jr. Bedford, Mass., Electron. Systems Div., Feb. 1965 110 p refs Prepared under subcontract for United Aircraft Corp. *Its* Rept.-7463-150
(Contract AF 19(628)-3437)
(ESD-TR-65-3; AD-611585)

This paper is a report on a continuing effort to develop a physical-numerical model suitable for use in predicting large-scale fields of low cloudiness. Included are a derivation of a basic prediction model and the results of a test series of 12-hr forecasts made with various versions of the model using synoptic data for the period: 12Z, 6 Feb.–00Z, 7 Feb. 1964. The tests were designed to assess the characteristics of the model and to indicate areas in which more study is required. The model tested differs broadly from previous boundary layer models in its use of all three space dimensions, a horizontal space mesh of 150 km, and a time step of 15 min. The model incorporates the computation of: eddy fluxes of heat and vapor, the transport of heat, vapor, etc. By ageostrophic horizontal winds, the influence of terrain- and frictioninduced vertical motion, and the heat and mass exchanges involved in water-substance phase changes. Author

N65-22089# Emmanuel Coll., Boston, Mass. Research Language Center
A THEORETICAL MODEL OF A CUMULUS CLOUD [TEORETICHESKAIIA MODEL KUCHEVOGO OBLAKA]
L. N. Gutman Dec. 1963 13 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 112, 1957 p 1033–1036
(Contract AF 19(628)-3869)
(E-T-R-64-15; AD-611033) CFSTI: HC $1.00/MF $0.50

A mathematical model is derived for the plane stationary problem of ordered thermal convection caused by the vertical instability of the atmosphere, with the assumption that there is no general air movement. The hydrodynamic patterns corresponding to the solution obtained are regarded as resembling a cumulus cloud. A specific example is calculated as an illustration of this conclusion. In the computed lines of flow, the cloud base lies at the level of condensation, the side boundary is drawn along the isoline w = 0. 1 m/sec (where w is the vertical component of the wind velocity), the upper boundary corresponds to the isoline w = o, the upper portion of the cloud resembles an anvil, and the anvil does not develop when there is weaker inversion. TAB

N65-22099# Chicago Univ., Ill. Cloud Physics Lab.
UREA AS AN ICE NUCLEANT FOR SUPERCOOLED CLOUDS
Robert G. Knollenberg 1 Apr. 1965 24 p refs
(Grant NSF G-22419)
(TN-29)

Urea was observed to have extraordinary ice-nucleating properties in laboratory and natural clouds. Ice nucleation was induced in laboratory clouds at temperatures as warm as +6° C. The nucleation mechanism involves the high endothermic heat of solution and high solubility of urea. Three field releases of urea in supercooled stratus resulted in marked visual transformation of the cloud, and substantial snow showers were produced. It is concluded that urea is an effective seeding reagent for supercooled clouds. In these experiments urea appeared to be equally effective as dry ice in causing shower formation. Author

N65-22135*# Lockheed-California Co., Burbank.
STUDY OF HIGH RESOLUTION WIND MEASURING SYSTEMS. PHASE I SURVEY, JULY THROUGH SEPTEMBER 1964
Fox Conner, W. W. Hildreth, Jr., and Ledolph Baer 16 Oct. 1964 49 p refs
(Contract NAS8-11286)
(NASA-CR-62295; LR-18313) CFSTI: HC $2.00/MF $0.50

A three-phase study of high resolution wind measuring systems is reported. The primary area of interest is the collection of detailed design data for winds at altitudes up to 20 km. The various measuring systems and schemes are described and their errors discussed. The concepts worthy of serious consideration appear to employ either a probe, a tracer, or sound. In addition to the system survey, the effect of wind variability on the representativeness of meteorological observations is explored. Author

N65-22141# Suffield Experimental Station, Ralston (Alberta).
ON THE GROUND DEPOSIT OF PARTICLES EMITTED FROM A CONTINUOUS ELEVATED POINT SOURCE. PART II: DEPOSIT OF NOMINAL 50μ GLASS MICROSPHERES FROM 8 METRES
E. R. Walker 20 Jan. 1965 40 p refs
(Suffield-TP-304; AD-457050)

The deposit densities of nine trials in which particulate matter, 50μ glass microspheres were released from a continuous point source at a height of 8 metres over prairie terrain, are reported. The observed crosswind-integrated ground deposits were used to test simple diffusion models, which employed as their main parameters of atmospheric diffusion appropriately averaged standard deviations of vertical wind vane angles. The results were not uniformly satisfactory but provide sufficient encouragement to justify additional testing of such models. The crosswind standard deviations of deposit were well predicted by the value of the standard deviation of the crosswind vane angle computed from appropriately averaged and sampled data. Rotorod samplers used to measure dosages and turbulent deposition velocities were unable to measure concentration gradients. Author

N65-22159# Pacific Missile Range, Point Mugu, Calif. Geophysics Div.
TURBULENCE CRITERIA DERIVED FROM CONVENTIONAL ATMOSPHERIC MEASUREMENTS
M. A. Wolf 19 Feb. 1965 11 p refs
(PMR-TM-65-1; AD-611101)

Measurements of wind speeds and temperatures from the television tower at Cedar Hill, Texas, are used in the evaluation of three criteria of turbulence. Expressions are derived which relate these calculated values to average turbulence values determined from measurements of the vertical component of turbulence at five levels on the tower. The closest correlation between turbulence and the calculated criteria is achieved with a nondimensional criterion which is introduced in the study. It is suggested that the expression, relating turbulence and the N criterion, will have application to other geographical areas, provided that local effects are reflected in the kinetic energy gradient term. Extension of the N criterion to clear air turbulence is considered feasible. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-21254# Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.
UAL/FAA ATC RADAR BEACON ALTITUDE REPORTING TEST Final Report
Felix F. Hierbaum, Jr. and Carlo Yulo Jan. 1965 39 p refs
(FAA-RD-65-10)

Participating aircraft were equipped with two different types of automatic altitude reporting configurations, and two different types of ground decoding and display systems were used. Information was gathered on adequacy of the ATCRBS pressure altitude transmission medium, the technical integrity of the two specific decoding and display systems, and correspondence between the pilot altitude display in the cockpit and the radar beacon altitude display at the ground facility. The data analyzed and controller comments on data received are included along with review notes. Author

N65-21539# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A PILOT DISPLAY CONCEPT FOR NEAR-TARGET MANEUVERS DURING RENDEZVOUS
D. W. Eliason and D. H. Utter 1 Mar. 1965 32 p refs
(LMSC-6-65-65-3)

A preliminary investigation was carried out for a translational control system concept for near-target maneuvers during rendezvous. The maneuvers are applicable to such missions as docking, inspection, and the Air Force Remote Maneuvering Unit. The concept consists of (1) a small constant thrust acceleration directed at the target by the maneuvering vehicle, (2) a phase-plane CRT representation of radar range and range

rate with superimposed overlay contours, and (3) a means for determining the appropriate scale factors for the phase-plane display in the general case. Translation is effected by suitable combinations of thrusting and nonthrusting periods. A pilot task description is given for a typical range change maneuver. Author

N65-21827# College of Aeronautics, Cranfield (England).
A MATHEMATICAL DERIVATION OF AIR TRAFFIC CONTROL SEPARATION STANDARDS
R. N. Lord and D. A. Saunders Dec. 1964 33 p refs
(COA-E&C-5)

Air traffic control is considered as a feedback control system dependent for its operation on positional information being supplied by the aircraft to the ground controlling authority. The mathematical model of the enroute phase of a long flight over unpopulated land or sea is considered, and the influence of the updating rate of positional information upon both lateral and longitudinal separation standards is studied for both subsonic and supersonic operations. Results of this mathematical approach to air traffic control indicate that more economic use can be made of existing airspace, and that future engineering development should be directed towards improving the heading accuracy and speed-keeping ability of future aircraft. Author

N65-21864# Royal Aircraft Establishment, Farnborough (England).
AN ANALYSIS OF JET TRAFFIC CROSSING THE NORTH ATLANTIC ON THE 7TH AND 8TH SEPTEMBER 1962
P. G. Reich and R. Towns London, Min. of Aviation, Apr. 1963 66 p refs
(RAE-TN-MATH-97)

Information recorded on flight progress strips and teleprinter messages has been used to study jet traffic controlled by the Gander, Prestwick, Reykjavik, Shannon and Sondrestrom Oceanic Area Control Centers during a busy period in 1962. An analysis is given of the distribution of the traffic in space and time, the extent of restrictions imposed by Air Traffic Control, and the accuracy of forecasting flight times between pairs of reporting points. Author

N65-21871# Royal Aircraft Establishment, Farnborough (England).
AIR TRAFFIC CONTROL SEPARATION STANDARDS AND COLLISION RISK
B. L. Marks London, Min. of Aviation, Feb. 1963 39 p refs
(RAE-TN-MATH-91)

The consideration of safety in an Air Traffic Control system is divided into two parts. The first part is concerned with the overall amount of proximity between pairs of aircraft which is planned or inherent in the system. It is shown how this may be analyzed and displayed by using mathematical models, by simulation on a digital computer, and by processing retrospective flight data. The second part is concerned with the risk of collision produced by proximity. This is a problem of gathering knowledge about very large errors in following a flight plan; such errors are necessarily rare events. A study is made of the amount of data that would be required to give worthwhile numerical estimates, and the amount does not appear prohibitive, although presently available data are inadequate to provide firm results. Techniques are demonstrated for the calculation of collision probabilities from such data. Author

N65-21872# Royal Aircraft Establishment, Farnborough (England).
AN EXERCISE IN COSTING THE EFFECT OF AIR TRAFFIC CONTROL RESTRICTIONS ON NORTH ATLANTIC TRAFFIC
P. G. Reich London, Min. of Aviation, Mar. 1963 54 p refs
(RAE-TN-MATH-90)

The costs borne by airline operators as a result of restrictions by Oceanic Air Traffic Control are estimated for the North Atlantic for 1961, 1964, and 1967. The 1964 and 1967 estimates are based upon fixed-track systems adjusted to the daily wind forecast. The analytical techniques used necessarily aim at an average interpretation of a wide variety of factors. As they may be controversial, they are described in detail. High, low, and intermediate estimates are presented to indicate the variability of this sort of exercise. Some methods for designing a route structure for least overall cost are described. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-21161*# Thompson Ramo Woolridge, Inc., Cleveland, Ohio.
OPERATION OF A FORCED CIRCULATION, CROLOY 9 M, MERCURY LOOP TO STUDY CORROSION PRODUCT SEPARATION TECHNIQUES
D. B. Cooper and E. J. Vargo Washington, NASA, Apr. 1965 102 p refs
(Contract NAS3-2538)
(NASA-CR-217) CFSTI: HC $4.00/MF $0.75

A Croloy 9M, forced circulation, mercury loop was designed and operated for a total of 2918 hours at an average boiling temperature of 1074° F. Corrosion product separators were included in both the vapor and liquid sections of the system and were evaluated for their effectiveness in reducing problems associated with mass transfer in mercury systems. Corrosion data for this system were found to agree favorably with previously reported data for Croloy 9M. The separators in the vapor portion of the system removed 54.3% of the corroded metals found in the system, while the separator in the liquid region removed 24.7% of the corroded metals. Carbon diffusion was noted in the Type 316 SS–Croloy 9M composite tubing at temperatures above 1200° F. The diffusion of carbon from the Croloy 9M to the Type 316 SS resulted in grain coarsening of the Croloy 9M and a profusion of carbides in the Type 316 SS. The composite tubing also exhibited excessive creep after 2918 hours at 1405 ±10° F, apparently a result of metallurgical changes in the Type 316 SS. Deposition and corrosive and/or erosive attack were observed, after 448 hours of loop operation, in a Croloy 9M throttling valve located at the superheater outlet. Author

N65-21198# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON ATOMICS AND REACTOR TECHNOLOGY [LITERATUUROVERZICHT, ATOOMKERNTECHNIEK EN REACTORKUNDE]
Dec. 1964 32 p refs In DUTCH *Its* 6th Yearly Issue, No. R-69

Brief reviews of papers on atomics and reactor technology are described. Contents include reactors, reactor technology, instrumentation of reactors, reactor physics, waste disposal, safety, rays and their measurement, isotopes and their applications, laboratories, and technical news. L.S.

N65-21263# Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS Tenth Monthly Progress Letter, Jul. 1964
17 Aug. 1964 6 p
(Contract AF 29(601)-5911)
(BSR-1008)

The program progress schedule, accomplishment of major portions of the program, total program expenditures and budget, and program personnel loading charts are presented. The initial analysis, including collection of data, radiation effects analysis, and design of experiments, is included under accomplishments. Preparation of test instrumentation, gamma-ray tests, and reactor tests are considered under experiments. Radiation effects are contained in the final analysis. E.E.B.

N65-21369# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center
INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE—1
William B. Cottrell et al Apr. 1965 151 p
(Contract W-7405-ENG-26)
(ORNL-NSIC-8)

Reports on safety in nuclear powerplants, reactors, materials handling, and facility operations are presented. Indexed by subject and personal author, the abstracts are listed under 18 category headings with an added category for nonannotated bibliographies. E.P.V.

N65-21397# Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
THE H-4, H-5, AND H-6 IRRADIATION EXPERIMENTS: IRRADIATION OF N-REACTOR GRAPHITE Interim Report No. 1
J. W. Helm Oct. 1964 99 p refs
(Contract AT(45-1)-1350)
(HW-81250-A) CFSTI: $4.00

Irradiations were performed in the D7 and F7 positions of the GETR to determine the long-term irradiation behavior of N-Reactor moderator graphite, designated TSX. Results were given for samples irradiated to a maximum neutron exposure of 4.8×10^{21} nvt, $E > 0.18$ MeV. Mean sample temperatures, which ranged from 425° to 825° C, agreed within ±50° C from capsule to capsule and from one reactor cycle to the next. The TSX graphite tested was obtained from three separate full-size unmachined blocks. The contraction of the graphite showed a dependence on the temperature of irradiation. The transverse samples showed a large spread in contraction for several samples irradiated at the same temperature to equivalent exposures, with no statistical differences among samples taken from several locations in the block. All TSX samples showed continued contraction upon increased neutron exposure, and the parallel samples contracted more and at a faster rate than did the transverse. The TSX graphite showed nearly the same contraction behavior as the CSF graphite in both the transverse and parallel orientations. Data on radiation-induced changes of sample volume, crystallite parameters, Young's modulus, and electrical resistivity are also presented. Author

N65-21428# Los Alamos Scientific Lab., N. Mex.
ULTRA HIGH TEMPERATURE REACTOR CRITICAL EXPERIMENT (UCX) SAFETY ANALYSIS REPORT
31 Mar. 1965 99 p refs
(Contract W-7405-ENG-36)
(LA-3279) CFSTI: $4.00

The UHTREX Critical Experiment uses the core, reflector, fuel elements, and control rod materials of UHTREX to produce data for the verification of nuclear design calculations. Components of the critical assembly and the plans for its operation are described and discussed, as are the location and design features of the test facility. Hazards that might arise during UCX operation are described and the consequences analyzed. Consequences of conceivable excursions are minor, with effects limited to the assembly test cell. Author

N65-21429# Battelle-Northwest, Richland, Wash.
POSTIRRADIATION EVALUATION OF ZIRCALOY-2 PRTR PRESSURE TUBES—PART III
M. C. Fraser Jan. 1965 18 p refs
(Contract AT(45-1)-1830)
(BNWL-5) CFSTI: $1.00

Three zircaloy-2 pressure tubes have been discharged from the plutonium recycle test reactor and specimens from two of these tubes and from other tubes have been burst tested. Unirradiated as well as irradiated pressure tubes have been used for room temperature crack propagation tests. The results of vacuum fusion analysis for hydrogen content of specimens from all discharged pressure and pressure loss tubes established the following selection basis for PRTR Zircaloy-2 pressure tubes: (1) Tubes having fast neutron exposure of 10^{21} or less have a high strength with ductility. (2) Exposure of 5×10^{20} nvt or less does not affect the crack propagation resistance; crack length necessary for propagation at PRTR operating pressure is about 10 in. (3) General levels of hydride concentration are low, but high hydride concentrations have been found at flaws. The worst combined effect of flaw plus hydride reduced strength by 25%. G.G.

N65-21430# Battelle-Northwest, Richland, Wash. Chemistry Dept.
PROMETHIUM-146, FISSION PRODUCT, AND TRANSURANIUM ISOTOPE CONTENT OF POWER REACTOR FUELS Comprehensive Chemical Analyses
F. P. Roberts and H. H. Van Tuyl Mar. 1965 19 p refs
(Contract AT(45-1)-1830)
(BNWL-45) CFSTI: $1.00

Fuel samples from the Yankee and the Vallecitos water reactors were analyzed radiochemically to determine the isotopic purity of the fission product promethium. The maximum ratio of Pm^{148} to Pm^{147} for the Yankee reactor was 4.7×10^{-6} on a curie basis with little variation between samples of different reactor exposure time. The fuel samples from Vallecitos contained significantly less Pm^{148} per curie of Pm^{147} with approximately 1×10^{-6}. It was concluded that low gamma dose-rate promethium for isotopic heat source applications containing 4-ppm Pm^{148} will require no more shielding than Pu^{238} for many applications. The amounts of Sr^{90}, Cs^{137}, Pm^{147}, Tc^{99}, total palladium; Am^{241}, Cm^{242}, Cm^{244}, Np^{237}, as well as uranium and plutonium isotopes found in both of the fuels, are presented in tables. G.G.

N65-21440# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
BURNUP DETERMINATION OF NUCLEAR FUELS Annual Progress Report, 1963

J. E. Rein and W. J. Maeck, ed. Nov. 1964 29 p refs
(Contract AT(10-1)-205)
(IDO-14649) CFSTI: $2.00

This report describes the status of the project to develop methods for the determination of burnup of nuclear fuels. The emphasis is on high burnup fuels. The major analytical technique being investigated is stable fission product analysis. Author

N65-21493# Oak Ridge National Lab., Tenn. Reactor Div.
OPTICAL MAPPING OF OAK RIDGE RESEARCH REACTOR EXPERIMENT TUBES
A. A. Abbatiello Apr. 1965 21 p refs
(Contract W-7405-ENG-26)
(ORNL-3781) CFSTI: $1.00

The as-built positions of 10 experiment tubes within the Oak Ridge Research Reactor (ORR) pressure vessel were obtained from an overhead bridge above the reactor with optical tooling instruments adapted for vertical viewing. A special mapping tool provided the specific location of experiment tubes with respect to a vertical reference line of sight. A transit capable of moving in X–Y directions mounted on the service bridge formed the reference zero for the vertical line from which the desired surfaces were located. All the required points were fixed in rectangular coordinates and dimensioned from the reactor access flange centerline. Scale plots were made for all experiment tubes at 10-in. elevation levels between the top of the core and the access flange. The results show that most of the tubes occupy their designated areas, but some deviate to an extent that limits available space for future experiments. The optical tooling used in this application with mapping tools and a pentaprism for viewing otherwise inaccessible regions demonstrated (1) ability to locate points in a high radiation field safely through shield water, (2) acceptable precision (±0.05 in. through 8 ft of water), and (3) rapid manipulation. Author

N65-21528# Battelle-Northwest, Richland, Wash. Chemistry Dept.
VALUES IN SPENT FUEL FROM POWER REACTORS
C. A. Rohrmann Mar. 1965 47 p refs
(Contract AT(45-1)-1830)
(BNWL-25) CFSTI: $3.00

The magnitude of future amounts of byproducts available from discharged reactor fuels is appraised; the candidate materials which are most likely to have value are established; simplified ground rules for appraising value and recovery cost are proposed; the value of candidate materials in unprocessed fuels are estimated; and the chemistry and technology of economical recovery processes are defined. Results of these investigations are tabulated. It was concluded that the processor may find items of profitability among the byproducts available from discharged reactors. At the level of credit for absorbed neutrons used in the study, very high returns to the fuel owner were indicated which could significantly lower the cost of power. Credit for the fissionable plutonium isotopes at the published price of $10/g assures the soundness of the economics of fuel processing. E.E.B.

N65-21529# Battelle-Northwest, Richland, Wash.
NONDESTRUCTIVE TESTING OF ISOTOPE HEAT SOURCES Interim Report
R. W. Steffens, D. R. Green, and G. F. Garlick Apr. 1965 25 p refs
(Contract AT(45-1)-1830)
(BNWL-51) CFSTI: $2.00

Tests that are being developed are described, and data taken using prototype test equipment on simulated-nonradioactive heat sources are presented. An ultrasonic test technique that uses specially designed transducers and electronic readout circuits to detect and classify flaws in the weld volume, core material, and within the container wall and to obtain profile maps of cladding thickness is discussed. Also, a mechanical system for the inspection of the entire surface of both cylindrical and spherical sources of various sizes is described. A conceptual view of a nondestructive testing system for isotope heat sources is included. Normal incidence test, flaw detection using 45° shear waves, low-frequency core testing, and the critical angle test are discussed. The electronic circuitry associated with cladding thickness measurement and flaw detection is also given. Further, the time transient infrared method for the detection of thin cracks around the cores of heat sources is developed. E.E.B.

N65-21645*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BACKSCATTERING AND SECONDARY-ELECTRON EMISSION FROM METAL TARGETS OF VARIOUS THICKNESSES
Allan J. Cohen and Kenneth F. Koral Washington, NASA, Apr. 1965 35 p refs
(NASA-TN-D-2782) CFSTI: HC $2.00/MF $0.50

Measurements were made of the number of backscattered and secondary electrons resulting from the impingement of primary electrons in the energy range 0.6 to 1.8 MeV upon thin targets of seven metals. The materials ranged from aluminum, with an atomic number of 13, to gold, with an atomic number of 79. Included in the investigation were the effects upon backscattering and secondary-electron coefficients of changes in both primary-electron energy and angle-of-incidence, as well as target thickness and atomic number. It was determined that a thickness equivalent to, or greater than, one-half range acts as an infinite backscatterer. Also, it was found that an energy-independent correlation of backscattering yield with thickness exists for each metal target. A linear increase in the secondary-electron coefficient with the backscattering coefficient was observed. Backscattering coefficients were measured as low as 0.4% and as high as 62%, and secondary-electron yields ranged from 1.1% to 5.2%. Author

N65-21693# Oak Ridge National Lab., Tenn. Neutron Physics Div.
DETERMINATION OF THERMAL-NEUTRON FLUX DISTRIBUTIONS IN THE BULK SHIELDING REACTOR II BY COPPER WIRE ACTIVATION TECHNIQUES
G. T. Chapman Mar. 1965 54 p refs
(Contract W-7405-ENG-26)
(ORNL-3759) CFSTI: $3.00

The thermal-neutron flux distribution within the stainless steel bulk shielding reactor II has been determined by exposing copper wires at selected locations in the core during reactor operation. The gamma-ray activity resulting from thermal-neutron activation of the copper was counted as a function of position along the wire, and the results were converted to estimates of thermal-neutron flux by the methods described. The method of analysis was checked by independently exposing gold and copper wires at a common location in the reactor. The thermal-neutron fluxes obtained from analysis of both sets of data were in agreement within ~3%. The method was further checked by comparing the results of a wire exposure with calculations of the distribution made by the PDQ reactor code. Agreement was good in statistically important regions. Author

N65-21694# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires
FUEL CYCLES PHYSICAL STUDY FOR NATURAL-URANIUM GRAPHITE GAS-COOLED REACTORS [ETUDE PHYSIQUE DES CYCLES DE COMBUSTIBLES CENTRALE A GRAPHITE URANIUM NATUREL]
A. Meyer-Heine Brussels, EURATOM, Dec. 1964 175 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-004-62-9 ECIF)
(CEA-762; EUR-2208.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 160 Belg. Fr.

A refueling scheme is defined to obtain the longest life of the fuel element. To avoid the use of complex computer programs, lattice constants have been turned into simple formulas valid in the usual range of French reactors. The influence of burnup on the definition and economics of a powerplant is then studied. The possibility of obtaining burnup as high as 5500 MWD/T is shown. Particular problems such as isotopic composition, moderator temperature coefficient, and transitory cycles are considered. The use of U^{235} low enriched fuel is of a doubtful interest. The influence of uncertainties on the basic assumptions and in particular on effective cross sections, and the importance of a program of chemical and isotopic analysis of irradiated fuels, even with low burnups, are shown. Author

N65-21709# California Univ., Livermore. Lawrence Radiation Lab.
RADIOACTIVE EFFLUENT MONITORING AT THE NEVADA TEST SITE FOLLOWING NUCLEAR DETONATIONS
R. L. Gotchy 21 Dec. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-12272) CFSTI: $2.00

The methods presently employed for the control, monitoring, and evaluation of fission product releases to the atmosphere during postdetonation drilling following nuclear underground detonations are presented. By the use of improved blowout preventers and rotating heads, releases of radioactive inert gases have been controlled and reduced to a minimum. Also, any releases which might occur are monitored instantaneously and accurately. These methods are novel, if not unique, and with suitable modifications could be used to monitor gaseous releases from reactors and chemical separations plants. The development of containment and monitoring systems, effluent monitoring with the Jordan ionization chamber, and the use of the scintillation counting system for radioactive effluent releases are discussed. E.E.B.

N65-21798# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM: SUMMARY OF NUCLEAR PHYSICS EXPERIMENTS
Robert E. Quilici Jan. 1965 111 p refs
(Contract AT(10-1)-880)
(IDO-28631) CFSTI: $4.00

The GCRE-I experimental reactor to provide core and fuel element information for the design of a demonstration powerplant, and the ML-1 demonstration powerplant were built and operated experimentally to establish the feasibility of a mobile nuclear powerplant. Various nuclear experiments were performed with critical assemblies in both reactors and are briefly summarized. G.G.

N65-21808# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
REACTOR FUELS AND MATERIALS DEVELOPMENT FOR FY 1964 Annual Progress Report
M. J. Graber, W. F. Zelezny, and G. W. Gibson Nov. 1964 54 p refs
(Contract AT(10-1)-205)
(IDO-17037) CFSTI: $3.00

Development work on UAl_3, UAl_4, U_3Si, UC, UN, UO_2, and U_3O_8 for fuel elements is reported. Electron microprobe analyses on aluminum dispersion type fuel plates were used to evaluate the effects of temperature on the stability of particulate uranium compounds. The changes in properties, stability with irradiation, and the effects of modifying fuel plate fabrication procedures were determined. Prototypes of new MTR or ETR type fuel elements containing uranium-bearing Fiberglas, U_3O_8, or UAl_3 were procured. Aluminum–beryllium alloys were evaluated and beryllium capsule experiments are underway. Aluminum–uranium intermetallic dispersions in aluminum are in a more concentrated form after irradiation than the uranium oxides. Foils containing B_4C can be used as a means of dispersing burnable poisons in fuel elements. Radiation does not interfere with the strengthening mechanism containing Al_2O_3 dispersions. The corrosion resistance of 50 wt% aluminum–beryllium alloy is microstructurally dependent. Author

N65-21810# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY, 1965
Russell W. Dayton and Stan J. Paprocki 1 Feb. 1965 47 p Supersedes BMI-1711
(Contract W-7405-ENG-92)
(BMI-1711, Del; BMI-1711) CFSTI: $1.00

CONTENTS:

1. REACTOR MATERIALS AND COMPONENTS (AEC-DRD) S. J. Paprocki 9 p
2. STUDIES OF FUELS (AEC-DRD) S. J. Paprocki 10 p
3. RADIOISOTOPE AND RADIATION APPLICATIONS (AEC-DID) J. F. Kircher 2 p
4. COATED-PARTICLE FUEL MATERIALS (AED-DRD) R. W. Dayton, J. H. Oxley, and C. W. Townley 16 p
5. GAS-COOLED REACTOR PROGRAM (AGN) D. L. Keller 5 p

N65-21816# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
DEVELOPMENT OF NONDESTRUCTIVE TESTING TECHNIQUES FOR THE HIGH FLUX ISOTOPE REACTOR FUEL ELEMENT
R. W. Mc Clung Apr. 1965 22 p refs
(Contract W-7405-ENG-26)
(ORNL-3780) CFSTI: $2.00

During fabrication development for the High Flux Isotope Reactor fuel element, several nondestructive testing methods were studied, developed, and applied to the evaluation of various properties. The properties tested include determinations of physical dimensions, detection of flaws, and measurement of the quantity and distribution of fuel material within the element and its component parts. These tests were necessary to provide assurance that its performance would be compatible with the designers' expectations in the extremely high thermal fluxes. The techniques included penetrating radiation methods for measurement of fuel concentration variables within each fuel plate. Eddy-current techniques were used during plate fabrication to provide identification of core orientation and after assembly into complete fuel elements to measure the coolant channel (plate-to-plate) spacing. Ultrasonics allowed removal of fuel plates containing nonbonds which would cause premature failure. Each method, which is described in

detail, was considered to be mandatory to assure the reliability of the fuel element due to its severe operating conditions. Author

N65-21820 Holmes and Narver, Inc., Los Angeles, Calif.
A STUDY OF RESEARCH REACTOR OPERATING AND SAFETY EXPERIENCE
B. J. Garrick, W. C. Gekler, J. M. Duncan, R. H. Karcher, and B. Shimizu 12 Jun. 1964 651 p refs
(Contract AT(04-3)-424)
(HN-180) CFSTI: $6.75

The operation and safety experience of 10 research reactors is presented covering historical data, management and methods of operation, and experience with physical systems. Source data were selected with emphasis on experience relevant to nuclear safety, assuming a close coupling between nuclear safety, administrative control, and reactor systems performance. Certain outstanding experiences are discussed as examples of particular interest. Definitions and rules used to establish consistency in reporting unscheduled power reduction at each research reactor are also included. G.G.

N65-21850# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
MEASUREMENT OF THE PROMPT NEUTRON LIFETIME IN THE MARYLA REACTOR USING NOISE TECHNIQUE
W. Ciechanowicz, L. Labno, and J. Podgorski Nov. 1964 12 p ref
(Rept.-565/IX, XI)

The neutron lifetime of the MARYLA reactor was estimated by using the noise technique. On the basis of the data obtained from the photo-type record of the neutron flux noise, the autocorrelation function and power spectral density were calculated. Using the power spectral density, the transfer function and then β/l ratio were obtained. Author

N65-21861# Sandia Corp., Albuquerque, N. Mex. Nuclear Space Safety Dept.
AEROSPACE NUCLEAR SAFETY: RE-ENTRY FLIGHT DEMONSTRATION NUMBER TWO Final Report
H. E. Hansen, A. J. Clark, Jr., and A. E. Bentz 8 Apr. 1965 249 p Sponsored by AEC
(SC-RR-65-43) CFSTI: $6.00

The reentry flight demonstration (RFD-2) reentry system, the instrumentation used to cover the flight, the data obtained, and an evaluation of the RFD-2 operational safety flight test of the SNAP test unit are given. The SNAP test unit used was an inert version of an isotopic generator characteristic of isotope-powered generators of the SNAP-9A, IMP-mission, and SNAP-19 category. The flight was highly successful and met essentially all of the test objectives. Also included are subsidiary experiments, telemetry, reentry system and Scout trajectories, generator thermal analysis, and optical analysis. L.S.

N65-21916# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Chemie
THE PLASMA BURNER AND ITS APPLICATION TO THE MELTING OF VARIOUS MATERIALS INTO CIRCULAR SHAPES [DER PLASMABRENNER UND SEINE VERWENDUNG ZUM RUNDSCHMELZEN VERSCHIEDENER MATERIALIEN]
A. Strigl and H. Bildstein [1964] 24 p refs In GERMAN Submitted for Publication
(SGAE-CH-12/1964)

Blowing of a gas jet through the circular copper anode led to the arching of the light arc between a tungsten cathode and the copper anode. Cooling of the anode and the cathode by its own water system made it possible to obtain a 1000-amp plasma for constant periods and the melting of a variety of metal particles of grain size up to 300μ into round shapes. Utilization of a helium plasma resulted in spherical melts of silver and copper particles up to 1000μ diameter, tungsten melts of 500μ diameter, nickel melts of 400μ diameter, uranium carbide and molybdenum carbide melts of 500μ diameter, aluminium oxide melts of 500μ diameter, and zirconium oxide and yttrium oxide melts of 500μ diameter. Transl. by G.G.

N65-21918# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Physik-Institut
DETERMINATION OF NUCLEAR FUEL WASTE WITH THE HELP OF MASS SPECTROMETRIC METHODS [ABBRANDBESTIMMUNG VON KERNBRENNSTOFFEN MIT HILFE MASSENSPEKTROMETRISCHER METHODEN]
F. P. Viehbock [1964] 20 p refs In GERMAN Presented at the Herbsttagung der Osterreichischen Physikalischen Ges., Graz, 1964 Submitted for Publication
(SGAE-PH-11/1964)

The mass spectrometric analysis of uranium isotopes or isotopic fission products is discussed. A few drops of the investigated substance are deposited on the inside of the two outer filaments of a three-filament surface ionization probe. Heating of the two outer fibers leads to the evaporation of the molecules and subsequent dissociation and ionization on the high-temperature center filament that consists of tungsten or tantalum. The volatilized ions are accelerated by an electric field into the analyzing magnetic flux and dissipate their energy in a Faraday collector. The analyzing field of the mass spectrometer consisted of a rotation symmetric magnetic field which produced the spectra by magnetic scanning. A typical spectrum of a uranium probe is presented. A special ionization source was developed and is described that prepares the nuclearization probes by thermal treatment and chlorination. Transl. by G.G.

N65-21919# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Physik-Institut
NEW METHODS AND APPLICATIONS OF GAMMA SPECTROSCOPY [NEUE METHODEN UND ANWENDUNGEN DER GAMMASPEKTROSKOPIE]
P. Weinzierl [1964] 31 p refs In GERMAN
(SGAE-PH-12/1964)

The advantageous application of semiconductors in nuclear gamma-ray spectroscopy is discussed. A review of the characteristic properties of gamma spectrometers including those employing semiconductors is given, and the suitability of a variety of nuclear semiconductors for gamma spectroscopy is observed by determination of (1) the intrinsic efficiency expressed in the ratio of registered energy elements in the atoms to the electron bombardment; and (2) the solid angle of the spectrometer opening from the gamma source. The effective ranges of γ-diffraction spectrometers, secondary electron spectrometers with magnetic energy analysis, and secondary electron spectrometers with conversion of the absorbed energy are presented in tables. Transl. by G.G.

N65-21931# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Oct.–31 Dec. 1964
R. H. Chesworth 15 Feb. 1965 89 p refs
(Contract AT(10-1)-880)
(IDO-28641) CFSTI: $3.00

This document summarizes the technical progress of the Army gas-cooled reactor systems program to develop a mobile, low-power, nuclear powerplant for military field operation. Analysis of the thermodynamic test data indicates the net powerplant output was about 30 kW less than during earlier runs. Author

N65-22102# Los Alamos Scientific Lab., N. Mex.
OPTIMAL CONTROL OF NUCLEAR REACTOR PROCESSES
Ronald R. Mohler (Ph.D. Thesis—Michigan Univ.) 8 Apr. 1965 156 p refs
(Contract W-7405-ENG-36)
(LA-3257-MS)

Two problems analyzed are the minimum-time control of a nuclear reactor fission process, and the optimal control of a direct cycle heat-exchange process to minimize the consumption of coolant. The reactor state is defined by the classic neutron kinetic equations in the first problem. In the latter problem, the system is coupled to a single stage heat-exchange model by coolant density reactivity and core temperature reactivity. The neutronics control must bring the neutron density from an initial steady state condition to a desired terminal steady state condition in the minimum time within allowable safety limits of reactivity change. Although mathematical analysis suggests open loop control, in practice open loop control is unstable. A simple continuous type of closed loop control with reactivity physically constrained to the allowable set is found to approach optimum system performance. With respect to other nucleonics performance indices, the bang-bang trajectory in combination with singular types of trajectories is optimal. In minimizing propellant consumption, the optimal variation in coolant mass flow rate is also a bang-bang process. When a constraint in reactor power and a stall constraint in the performance of the propellant pumping system are considered, the optimal control process is further complicated. M.P.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-21197# Admiralty Research Lab., Teddington (England).
CROSS-CORRELATIONS BETWEEN SHAPED TONE-PULSES
E. M. Wilson Sep. 1964 19 p
(ARL/M/N5; AD-455175)

The envelope is obtained of the cross correlation between two equally shaped tone pulses of the same duration but slightly different frequencies, when the shaping consists in making each pulse envelope a part of a sine curve, symmetric about the midpoint. Author

N65-21262# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE INTERPOLATION OF THE WAVE FUNCTION AND THE JOST FUNCTIONS IN THE ENERGY PLANE
K. Chadan Mar. 1965 11 p refs
(Th./88)

Some interpolation formulas in energy for the wave function and the Jost functions are derived in the case of central potentials having a finite radius. These formulas provide uniformly convergent series expansions, valid in the entire energy plane, for each function, when its values on a discrete set of the real axis are known. Author

N65-21433*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR ESTIMATING RATIO OF ABSORPTANCE TO EMITTANCE
Robert R. Hibbard Washington, NASA, Apr. 1965 15 p refs
(NASA-TN-D-2751) CFSTI: HC $1.00/MF $0.50

A graphical method is presented for estimating the values of the ratio of absorptance to emittance α/ϵ that can be achieved with surfaces having a high degree of spectral selectivity. The ratio of source to surface temperature is the parameter in the graphs. In principle, the results of the calculations presented are general and apply for any source or surface temperature. In practice, the ratios of absorptance to emittance so estimated can be used in radiant-heat-transfer calculations involving space vehicles. In this case α becomes α_s, the total normal absorptance of a surface to solar radiation, and ϵ is the total hemispherical emittance. Author

N65-21481*# Michigan Univ., Ann Arbor. Radiation Lab.
A NOTE ON DIELECTRIC LENSES
P. L. E. Uslenghi [1958] 11 p refs Submitted for Publication
(Grant NsG-444)
(NASA-CR-56595) CFSTI: HC $1.00/MF $0.50

Spherical and cylindrical dielectric lenses are considered, with radius assumed equal to unity, and with index of refraction N(r) a function of the distance r from the center of the sphere or from the axis of the cylinder. Only the geometrical properties of optical ray paths are investigated; and, since only those rays lying in planes perpendicular to the cylinder axis are treated, the geometry is the same for both lenses. N(r) is assumed continuous with its first derivative in $0 < r < 1$, and is finite except possibly at $r = 0$, and $N(1) = 1$. The optical ray enters the lens at P_1 with an angle of incidence α, is smoothly deviated along the curved path P_1P_2, and leaves the lens at P_2. R is the optical length of the path P_1P_2, and Θ is its angular extension as seen from the center $r = 0$. The deviation δ from the direction of incidence is: $\delta = \Theta + 2\alpha - \pi$. Equations are shown which give N(r) in parametric form. Expressions for R, Θ, and $\ln r$ are derived for the case in which $f(\xi)$ is an analytic function of the parameter ξ in a neighborhood of $\xi = 0$. The restrictions on the coefficients of the power series representing $f(\xi)$ required for physically significant solutions are pointed out. E.P.V.

N65-21487# India. Dept. of Atomic Energy, Bombay. Electronics Div.
GENERAL EQUATIONS OF MOTION OF A TWO-AXIS GYRO
S. V. Kasargod 4 Dec. 1964 12 p refs
(AEET/ED/SG/22)

The general equations of motion of a two-axis gyro are derived from the basic equations of angular momentum and inertial reaction, and expressed in general torque equations. The equations for the following gyro devices with vehicle fixed axes are presented: single axis gyro, rate gyro, rate integrating gyro, Foucault gyro compass, two-axis gyro, free gyro, pendulous gyro compass, gyro pendulum, and servoed gyro pendulum. G.G.

N65-21504# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

THE ACOUSTICS OF SOLID PROPELLANT COMBUSTION INSTABILITY Quarterly Technical Progress Report

8 May 1964 7 p

(Contract DA-19-020-AMC-5755-R)

(QTPR-6; AD-455137)

The flow dependent vent impedances, for piston-like as well as for antisymmetric modes of vent oscillations, were evaluated analytically on the basis that the acoustic motions in the vent behave as quasi-state hydraulic efflux motions from an orifice. Indications are that maximum losses occur at the minimum flow velocity at which the use of the hydraulic efflux expression is permissible. Experimental work with several vent geometries using a simulated T-burner compared favorably with the analysis. The losses of the resonant T-burner system changed by a factor of three over the range of the investigated flow velocities. G.G.

N65-21509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOTION OF AN ASYMMETRICAL GYROSCOPE PENDULUM

P. M. Alabuzhev, I. Ya. Shpigel'burd, and A. N. Borisova 10 Jun. 1963 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Mashinostr. (Moscow), no. 6, 1962 p 64–70

(FTD-TT-63-467/1+2+4; AD-410930)

Differential equations are derived for the motion of a gyro pendulum having small asymmetry relative to the polar axis with small deflections from the vertical. These equations have been integrated for the case where only one moment of gravity acts on the gyro compass, and this reveals the influence of the static and dynamic asymmetry of the pendulum. Author

N65-21553# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.

STUDIES IN PARTIAL COHERENCE AND NONLINEAR OPTICS

John G. Meadors (Ph.D. Thesis) 30 Nov. 1964 111 p refs (Contract AF 33(657)-10824)

(Rept.-1579-17; AD-460733)

Two important topics in physical optics are considered: optical coherence, and nonlinear interaction of light waves in dielectrics. The conditions on the optical fields necessary for ergodicity are specified. The detector response is found to be of fundamental significance in the interpretation of experimental results. The interpretation of information, obtained in typical experiments, on the coherence properties of an optical field is discussed. A quantum mechanical description of interference phenomena between independent laser sources is given. It is shown that coherent states of the radiation field, which are not energy states, give rise to interference effects whose description formally corresponds to the classical treatment of the fields. If the state of the radiation field corresponds to mixed energy states, the interference is due to the intensity correlation at two space–time points. The importance of crystal orientation in the achievement of nonlinear interactions in dielectrics is discussed and demonstrated through the analysis of realistic experiments. A theory of nonlinear interactions in dispersive dielectrics is given, in which beam divergence and frequency spread in the laser fields are treated. The results of the analysis specify the limitations of the plane-wave theory. The role of coherence on nonlinear interactions is considered. Author

N65-21580 Smithsonian Astrophysical Observatory, Cambridge, Mass.

HAMMING'S METHOD FOR INTEGRATING THE EQUATION OF HYDROSTATIC EQUILIBRIUM

Owen Gingerich *In its* Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 56–60 refs (See N65-21575 11-30)

For integrating the equation

$$dP = \frac{g}{k}\,d\tau$$

over logarithmic steps in τ, we have

Predictor: $${}_pP_n = P_{n-4} + \frac{4}{3}g\left(\frac{\ln 10}{S}\right)\left[Q + 2\frac{\tau_{n-3}}{k_{n-3}}\right];$$

Corrector: $${}_cP_n = \frac{1}{8}\left[9P_{n-1} - P_{n-3} + 3g\left(\frac{\ln 10}{S}\right)\left(Q + 2\frac{\tau_{n-3}}{k_{n-3}}\right)\right];$$

$$P_n = {}_cP_n + \frac{9}{121}\left[{}_pP_n - {}_cP_n\right],$$

where $$Q = 2\frac{\tau_{n-1}}{k_{n-1}} - \frac{\tau_{n-2}}{k_{n-2}},$$

and S is the number of τ steps per decade. This procedure is supposed to be used with a variable step size, made small enough to keep the predictor arbitrarily close to the corrector. By using 20 steps per decade, this is almost always satisfied, and no iteration is required for the pressure at step n. However, little harm is done in using the corrector pressure to find a better opacity, and thus iterating for a new corrector until a satisfactory solution is obtained. Author

N65-21627*# National Aeronautics and Space Administration, Washington, D. C.

SOUND PROPAGATION IN A TURBULENT ATMOSPHERE [O RASPROSTRANENII ZVUKA V TURBULENTNOY ATMOSFERE]

V. Krasil'nikov Jul. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 47, no. 7, 1945 p 486–489

(NASA-TT-F-9062) CFSTI: HC $1.00/MF $0.50

The fluctuations in the phase of a sound wave observed during the propagation of sound in a turbulent atmosphere are discussed. The following formula was obtained for the mean square fluctuation of phase:

$$\sigma\phi = \sqrt{\overline{\phi^2}} = \text{const}\,(\omega/c^2)\,CL^{1/2}B^{5/6},$$

where const has the value of the order of unity. A dependence of the phase fluctuations on wind speed in the frequency range of 2000 to 5000 cps that was very close to direct proportionality was established. This fact can be explained by the derived formula, if it is postulated that the turbulence characteristic C is directly proportional to the wind speed. Such a dependence is quite natural in view of the statistical theory of turbulence and is in conformity with the results obtained from the measurements of turbulence in the near-ground layer. Equations are also developed for the mean quadratic variability of the phase and the mean square angular error of the sound detector due to turbulence. R.W.H.

N65-21632*# National Aeronautics and Space Administration, Washington, D. C.
A GYROSCOPIC STABILIZATION PROPERTY OF A CONTROLLED CONSERVATIVE MECHANICAL SYSTEM [OB ODNOM SVOYSTVE GIROSKOPICHESKOY STABILIZIRUYEMOSTI UPRAVLYAYEMOY KONSERVATIVNOY MEKHANICHESKOY SISTEMY]
N. N. Krasovskiy Apr. 1965 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 5, 1964 p 156–164
(NASA-TT-F-9324) CFSTI: HC $1.00/MF $0.50

A stabilization property acquired by a not completely controlled conservative mechanical system with the application of additional gyroscopic forces is investigated. It is established that an intrinsically unstable conservative system subjected to the gyroscopic effect can only acquire the property of stabilization by a control force of general nature, whereas control by a dissipative force necessarily upsets the stability in this case. The effect discussed can be used for the regulation of a mechanical system with a large number of degrees of freedom, when the initial construction of the controlled object does not provide sufficiently complete transference from the control units to all of the regulated components. Author

N65-21633*# National Aeronautics and Space Administration, Washington, D. C.
SOLUTION OF A PROBLEM IN THE CONTROL OF THE MOTION OF NONLINEAR SYSTEMS
Nguyen Tkhan' Bang Apr. 1965 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 5, 1964 p 165–172
(NASA-TT-F-9325) CFSTI: HC $1.00/MF $0.50

An approximate method is given for solving a problem in the control of the motion of nonlinear systems. The convergence of the successive approximations is demonstrated. A procedure is indicated for implementing the solution of this problem on electronic analog equipment. As an application of the method, the problem of the accelerated drive of an Anschütz gyrocompass in the meridian is solved when the latter instrument has a nonlinear restoring force. Author

N65-21644*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF SHIELDING ON THE COULOMB T MATRIX
William F. Ford Washington, NASA, Apr. 1965 30 p refs
(NASA-TN-D-2781) CFSTI: HC $2.00/MF $0.50

The Coulomb T matrix is defined as the limiting value of the T matrix for a screened Coulomb potential when the screening is slowly turned off. Study of this limiting process is facilitated by an expansion in spherical harmonics, and the $l = 0$ term is treated in detail. The amplitude of the T matrix changes rapidly as a function of energy in the vicinity of certain critical points. The precise value of the T matrix in these regions requires that screening be taken into account, and the appropriate formulas are derived. An expression for the T matrix previously derived by Hostler is shown to be correct except in the critical regions. Author

N65-21648*# National Aeronautics and Space Administration, Washington, D. C.
PARTICLE-LIKE SOLUTIONS TAKING INTO ACCOUNT GRAVITATION [CHASTITSEPODOBNYYE RESHENIYA S UCHETOM GRAVITATSII]
M. I. Stakvilevichus Apr. 1965 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 3, 1964 p 86–90
(NASA-TT-F-314) CFSTI: HC $1.00/MF $0.50

The effect of gravitation on particle-like solutions is investigated for the case of a scalar complex potential when the gravitational field is produced only by the mass of a spherically symmetric scalar potential. It is shown that the gravitational interaction is negligible if the ratio of the gravitational radius to the radius of the particle is much less than unity. Thus for a particle with a radius of $r_0 \sim 10^{-13}$ cm and a mass of $\mu \sim 10^{-27}$ gm, the gravitational correction is approximately 10^{-40}%. Author

N65-21691# Conductron Corp., Ann Arbor, Mich.
COHERENT LIGHT INVESTIGATION, VOLUME III
G. Cochran, L. Cutrona, A. Ingalls, I. Kay, A. Sabersky et al Wright-Patterson AFB, Ohio, ASD, Oct. 1964 111 p refs
(Contract AF 33(615)-1014)
(D-5210-72-T80-110; AD-610082)

A new theory is presented for analyzing optical systems in terms of transfer functions and optical systems employed normally with coherent light. Also, the general theory of holograms and complex spatial filters are discussed. The production of two- and three-dimensional holograms using coherent light, and its implications for synthetic antenna applications, complex filters, matched filters, and general filtering systems are described. Practical details on experimental results are also given. Discussions are presented on the use of a laser for measurements of target acceleration and rotation rates and on the problem of testing large reflective optics. Author

N65-21697# Hughes Aircraft Co., Culver City, Calif.
A SELECTED BIBLIOGRAPHY ON POWER SPECTRUM ANALYSIS, JANUARY 1961–AUGUST 1964
Janice L. Hanks, comp. Oct. 1964 11 p refs
(LS-BIB-64-3)

N65-21715# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering Dept.
NONSTATIONARY EXCITATION AND RESPONSE IN LINEAR SYSTEMS TREATED AS SEQUENCES OF RANDOM PULSES
Y. K. Lin Nov. 1964 27 p refs
(AAE-64-7)

The problem of the nonstationary excitation and hence the nonstationary response of a linear system is treated by assuming that the excitation is a superposition of random pulses. Under this assumption the response is another superposition of random pulses. The simplest case in which the excitation is a nonstationary shot noise, that is, the excitation pulses are the Dirac impulses which arrive according to a nonhomogeneous Poisson probability law, is considered first. The log-characteristic functional of the response process, which gives complete statistical information about the response, is obtained. Then consideration is extended to an arbitrary shape for the excitation pulses and to non-Poisson pulse arrivals. For use in the frequency domain analysis of the second-order statistics, the expressions are given for the generalized spectral density of the excitation or the response process. Author

N65-21751# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
ON THE SOLUTION OF THE BBGKY EQUATIONS FOR A DENSE CLASSICAL GAS
Frank C. Andrews 30 Oct. 1964 42 p refs
(Grant NSF G-20725)
(WIS-TCI-70)

The low-order BBGKY equations are solved formally by being expressed in the form of integral equations. A density expansion is introduced to break the hierarchy. The functional equation for f_2 and two equivalent evolution equations for f_1 are formulated directly, correct to second order in the density. The results are compared with other treatments of the first density corrections to the Boltzmann equation and to the f_2 equation. The physical implications of the derivations are discussed. Author

N65-21773*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
THE SOUND FIELD FOR SINGULARITIES IN MOTION
M. V. Lowson 7 Dec. 1964 39 p refs
(Contracts NAS8-5384; NAS8-11308)
(NASA-CR-62226; WR-64-10) CFSTI: HC $2.00/MF $0.50

The general expression found for the sound field of a point force in arbitrary motion reduces to classical results for both uniform rectilinear motion and uniform circular motion of a point force. The solution shows that a fluctuating force in motion will have two components in its radiative sound field; the first an essentially dipole term due to the time rate of change of the force, and the second an essentially quadrupole term due to the acceleration of the system in which the force is acting. The expression determined for the sound field of a point source in arbitrary motion does not reduce to the classical result for uniform motion; it is concluded that the classical result does not take proper account of the momentum output associated with the source. The sound field for a point acoustic stress in arbitrary motion is determined and the accelerative effects are shown to produce higher order poles than the quadrupole normally associated with the acoustic stress tensor. Author

N65-21795# Los Alamos Scientific Lab., N. Mex.
AN ANALYSIS OF THE ABERRATIONS OF AN ASYMMETRICAL CZERNY-TURNER SPECTROGRAPH
Prince E. Rouse, Jr. 30 Mar. 1965 54 p refs
(Contract W-7405-ENG-36)
(LA-3201) Available from AEC, Oak Ridge, Tenn.: $3.00

Geometrical optics was used in a study of the aberrations of an asymmetrical Czerny–Turner plane-grating spectrograph. Conditions were found for obtaining a straight focal curve which does not change with rotation of the grating. The astigmatism and coma of a 5-meter instrument operating at about f/40 were calculated; the coma can be made negligible by proper choice of the lateral position of the entrance slit. Author

N65-21841# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
FEASIBILITY OF OBTAINING MEASUREMENTS OF PHOTOGRAPHIC IMAGE QUALITY FROM DENSITY TRACES OF EDGES—INTERNAL RESEARCH Final Report
H. B. Hammill and Thomas M. Holladay Mar. 1965 23 p ref
(CAL-132)

The results of a research program on the feasibility of obtaining measurements of photographic image quality from density traces of edges are reported. The measures of image quality sought were resolution, which corresponds to the value of spatial frequency at which the transfer function has dropped to a specified value; and passband, which is the area under the square of the transfer function. It was concluded that, within the accuracy required for most applications, an edge trace is a good source of these measures. Moreover, since the errors resulting from the use of the low contrast expression are comparable to those created by the termination of edge traces, the low contrast expression can be used whenever convenient. At present, there is no quantitative criterion for selecting termination points of a density trace. A method should be developed to perform this selection and the resulting errors in resolution and passband reevaluated. Further, realistic density traces should be examined to determine if the total density difference can be correlated with the trace behavior. E.E.B.

N65-21911# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
COMPUTATION OF A MODIFIED FRESNEL INTEGRAL ARISING IN THE THEORY OF DIFFRACTION BY A VARIABLE SCREEN
L. C. Walters and J. R. Wait 14 Oct. 1964 23 p refs
(NBS-TN-224) GPO: $0.20

The integral of the form

$$\int_{-\infty}^{+\infty} f(Z) \exp(-i\pi Z^2/2)\, dZ$$

is considered in this note. The function f(Z) varies from 0 to 1 in a monotonic fashion over the range of Z. Some numerical results are given which should be useful in certain diffraction and scattering problems involving objects of variable density. Author

N65-21962# Dublin Inst. for Advanced Studies (Ireland).
THE PETROV CLASSIFICATION OF GRAVITATIONAL FIELDS
J. L. Synge 1964 55 p refs /ts Ser. A, No. 15 Available from Dublin Inst. for Advanced Studies: 10s

The Géhéniau geometric approach to the problem of the Petrov classification of gravitational fields is developed analytically. Since the complex Euclidean 3-space is central in the Géhéniau method, this geometry is discussed in detail. L.S.

N65-22008# Army Electronics Research and Development Activity, White Sands Missle Range, N. Mex. Environmental Sciences Directorate
VARIATIONS IN THE SPEED OF SOUND DUE TO ATMOSPHERIC COMPOSITION
Richard D. H. Low Jan. 1965 13 p refs
(ERDA-253; AD-457960)

By means of a simple error propagation formula, it is shown that the usual variations in atmospheric composition may introduce an error no greater than about 2 centimeters per second in the computation of the sound speed and, therefore, should be of negligible concern in the routine utilization of acoustics in either sound ranging or sonic thermoanemometry. Author

N65-22058# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A NEW NON-RELATIVISTIC LIMIT OF THE POINCARE GROUP [UNE NOUVELLE LIMITE NON-RELATIVISTE DU GROUPE DE POINCARE]
Jean-Marc Levy-Leblond Mar. 1965 19 p In FRENCH; ENGLISH summary Submitted for Publication
(TH-91)

It is shown that, for the Galilean approximation to the Poincaré group to be valid, not only pure Lorentz transformation with low velocities, but also great time-like intervals, must be considered. Under the same conditions, the transformation properties of great space-like intervals are described by a group that is a new nonrelativistic limit of the Poincaré

group. This group, distinct from the Galilei group, is obtained from the Poincaré group by a contraction. The structure of this group and its Lie algebra are studied; their irreducible unitarity representations are constructed. In a world whose invariance group was this new group, there would be practically no causality. The name Carroll group is suggested for this degenerate cousin of the Poincaré group. This paper emphasizes the meaning and importance of a hitherto implicit condition for the validity of the Galilean approximation. Author

N65-22064# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTING AN OSCILLATING SYSTEM FOR STABILITY WITH THE AID OF COMPLEX COORDINATES
A. N. Obmorshev 18 Jun. 1963 13 p refs Transl. into ENGLISH from the book "Raschety Detaley i Mekhanizmov Tochnykh Priborov" Moscow, Gos. Nauchno-Tekhn. Izd. Mashinostr. Lit., 1960 p 39–49
(FTD-TT-63-329/1+2; AD-411207)

A method is described emphasizing the use of compression equations for the elimination of intermediary calculations when computing stability in oscillating systems. The use of compression equations for calculating movement in an oscillating or aperiodic system during the state of rest and during movement in the absence of outside influences is demonstrated. S.C.W.

N65-22066# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESS WAVES AND MOVEMENT OF BODIES
Josef Henrych 24 Mar. 1965 25 p refs Transl. into ENGLISH from Strojnicky Casopis (Czechoslovakia), no. 1, 1964 p 20–37
(FTD-TT-64-843/1+2; AD-460553)

The fundamentals of stress waves in elastic mediums are discussed and wave propagation rates of elastic waves, plastic waves, unstable waves, and stable steep shock front waves compared. Elastic wave theory, where the stress in waves does not exceed the elastic limit in the medium, is examined and a formula derived for wave behavior at a boundary between two media. Energy of elastic waves as represented by potential energy and kinetic energy is determined for rectangular wave forms. The motion of solid bodies on the basis of internal stress waves and the application of shock wave theory to impact between metal rods is also discussed. S.C.W.

N65-22206*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RELATIVISTIC ROTATION AND THE DISK PROBLEM
William C. Orthwein [1964] 11 p refs Submitted for Publication
(NASA-TM-X-51793) CFSTI: HC $1.00/MF $0.50

It is shown that the Ehrenfest paradox arising from the rotating disk problem may be resolved without resorting to a non-Euclidean geometry on the rotating disk, and without postulating a radial contraction to compensate for the circumferential Lorentz contraction. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-21150# California Univ., Livermore. Lawrence Radiation Lab. Scientific Information Systems Group
THRESHOLDS OF NUCLEAR REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan [1964] 385 p refs

CONTENTS:

1. THRESHOLDS FOR NEUTRON-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 40 p ref (See N65-21151 11-24)
2. THRESHOLDS FOR PROTON-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 48 p ref (See N65-21152 11-24)
3. THRESHOLDS FOR DEUTERON-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 48 p ref (See N65-21153 11-24)
4. THRESHOLDS FOR TRITON-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 48 p ref (See N65-21154 11-24)
5. THRESHOLDS FOR He^3-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 51 p ref (See N65-21155 11-24)
6. THRESHOLDS FOR He^4-INDUCED REACTIONS R. J. Howerton, D. L. Braff, W. J. Cahill, and N. Chazan 49 p ref (See N65-21156 11-24)
7. THRESHOLDS FOR GAMMA-INDUCED REACTIONS R. J. Howerton, D. Braff, W. J. Cahill, and N. Chazan 49 p ref (See N65-21157 11-24)
8. TABULATED NEUTRON-INDUCED GAMMA PRODUCTION CROSS SECTIONS FOR PRIMARY NEUTRON ENERGIES OF 0.1 TO 15 MeV N. J. Chazan 54 p (See N65-21158 11-24)

N65-21151 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR NEUTRON-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan May 1964 *In its* Thresholds of Nucl. Reactions [1964] 40 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14000)

This tabulation of thresholds for neutron-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König. The definition of the threshold used is the minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. All reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 1)/A]Q$. Author

N65-21152 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR PROTON-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan 2 Sep. 1964 *In its* Thresholds of Nucl. Reactions [1964] 48 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14001)

This tabulation of thresholds for proton-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König. The definition of the threshold used is the minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. All reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 1)/A]Q$. Author

N65-21153 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR DEUTERON-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan 3 Sep. 1964 *In its* Thresholds of Nucl. Reactions [1964] 48 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14002)

This tabulation of thresholds for deuteron-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis has been attempted. The definition of the threshold used here is this: the minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 2)/A]Q$. Author

N65-21154 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR TRITON-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan 3 Sep. 1964 *In its* Thresholds of Nucl. Reactions [1964] 48 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14003)

This tabulation of thresholds for triton-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis has been attempted. The definition of the threshold used here is this: the minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 3)/A]Q$. Author

N65-21155 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR He^3-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan 14 Sep. 1964 *In its* Thresholds of Nucl. Reactions [1964] 51 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14004)

This tabulation of thresholds for He^3-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis has been attempted. The definition of the threshold used here is this: the minimum kinetic energy of an impinging particle (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 3)/A]Q$. Author

N65-21156 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR He^4 INDUCED REACTIONS
R. J. Howerton, D. L. Braff, W. J. Cahill, and Nanette Chazan Jul. 1964 *In its* Thresholds of Nucl. Reactions [1964] 49 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCLR-14005)

This tabulation of thresholds for He^4-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted. The definition of the threshold used here is this: the minimum kinetic energy an impinging alpha particle (in the laboratory system) must have to make the reaction energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-[(A + 4)/A]Q$. Author

N65-21157 California Univ., Livermore. Lawrence Radiation Lab.
THRESHOLDS FOR GAMMA-INDUCED REACTIONS
R. J. Howerton, Donald Braff, W. J. Cahill, and Nanette Chazan 14 Sep. 1964 *In its* Thresholds of Nucl. Reactions [1964] 49 p ref (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14006)

This tabulation of thresholds for gamma-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted. The definition of the threshold used here is this: the minimum energy of an impinging photon (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of $-Q$. Author

N65-21158 California Univ., Livermore. Lawrence Radiation Lab.
TABULATED NEUTRON-INDUCED GAMMA PRODUCTION CROSS SECTIONS FOR PRIMARY NEUTRON ENERGIES OF 0.1 TO 15 MeV
Nanette J. Chazan 13 Jan. 1965 *In its* Thresholds of Nucl. Reactions [1964] 54 p (See N65-21150 11-24)
(Contract W-7405-ENG-48)
(UCRL-14007)

Gamma-production cross sections, both integrated and differential, are tabulated. The data are categorized according to whether the gammas produced are continuum, discrete, or total overall gamma energies. Author

N65-21182# European Atomic Energy Community, Brussels (Belgium).
CALCULATION OF THE FRACTIONAL RELEASE OF GASES FROM A SLAB AFTER RECOIL BOMBARDMENT
G. Di Cola and Hj Matzke (Braunschweig Tech. Univ.) Nov. 1964 28 p refs
(EUR-2157.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

The problem of the release of recoil gas atoms from a slab (infinite plane sheet) of inert material during postbombardment annealing is considered. Two initial conditions (rectangular and linearly decreasing concentration at $t = 0$) are assumed. Mathematical formulas for the fractional release F are derived and compared with experiments and literature. Using values obtained from a standard 7090 IBM electronic computer, figures and tables are given which relate F to a dimensionless function of the diffusion coefficient. Author

N65-21194# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
RELATIVISTIC THEORY OF THE ELECTRODISINTEGRATION OF THE DEUTERON. II. NUMERICAL RESULTS AND NEUTRON FORM FACTORS DETERMINATION

F. M. Renard, J. Tran Thanh Van, and M. Le Bellac Feb. 1965 54 p refs
(Th.-86)

Results are presented of a covariant theory of the electrodisintegration of the deuteron. The neutron form factors are determined by the quasi-elastic peak method; $F^N_{CH} \geq 0$ and $F^N_{MAG} \geq F^P_{MAG}$ is obtained. Author

N65-21243# Rochester Univ., N. Y. Dept. of Physics and Astronomy
GENERALIZED QUASI-SPIN IN NEUTRON-PROTON SYSTEMS
J. N. Ginocchio 19 Feb. 1965 69 p refs
(Contract AT(30-1)-875)
(UR-875-75)

Using the fact that, in a j^n configuration, the nucleon-number and isospin dependence for neutrons and protons in a seniority representation are incorporated in an R(5) quasi-spin group, the allowed values of isospin and the number of times it occurs for a given symplectic symmetry (seniority $\underline{S}$ and reduced isospin $\underline{t}$) and nucleon number is derived. Also closed form expressions for the R(5) Clebsch–Gordan coefficients are derived in which one of the irreducible representations is the four-dimensional representation, and the others have reduced isospin one and zero, and reduced isospin equal $1/2\,(2\underline{j} + 1 - \underline{S})$. All others needed for $\underline{j} \leq 7/2$ are calculated numerically. It is shown that these Clebsch–Gordon coefficients give the n, T dependence of the spectroscopic factors. A generalization is made immediately to mixed configurations. Author

N65-21247# India. Dept. of Atomic Energy, Bombay. Analytical Div.
A CHART OF GAMMA ENERGIES VS. HALF-LIFE FOR NUCLIDES PRODUCED BY (n, γ) AND (X-X') REACTIONS
S. Gangadharan, R. Krishnamoorthy Iyer, and M. Sankar Das 1964 10 p refs
(AEET/ANAL/32)

In activation analysis the use of gamma-ray spectrometry facilitates the identification of a given nuclide from the observed half-life and energy of the gamma ray. For the identification of a nuclide as well as the evaluation of interferences from other nuclides a plot of the gamma-ray energies against half-life is very useful. This form of plot is presented in the three graphs covering the energy ranges 0 to 300 keV, 300 to 800 keV and 800 keV to 3 MeV and for the half-life range of 1 sec to 5 years for nuclides produced by (n, γ) and (x-x') reactions. To have a quantitative idea, the photopeak activity of the characteristic gamma rays of the nuclide is given as an index. The activity produced by the irradiation of 1 μg of element to saturation at a flux of 10^{12} neutrons cm^{-2} sec^{-1} was used for calculating the index. Author

N65-21290 Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE DETERMINATION OF OSCILLATOR STRENGTHS IN ATOMIC SPECTRA. DETERMINATION OF OSCILLATOR STRENGTHS IN THE SPECTRA OF IRON AND NICKEL
N. P. Penkin and G. F. Parchevskii Jun. 1964 103 p refs
Transl. into ENGLISH from Soviet periodicals

CONTENTS:

1. THE DETERMINATION OF OSCILLATOR STRENGTHS IN ATOMIC SPECTRA N. P. Penkin 89 p refs (See N65-21291 11-24)

2. DETERMINATION OF OSCILLATOR STRENGTHS IN THE SPECTRA OF IRON AND NICKEL G. F. Parchevskii and N. P. Penkin 12 p refs (See N65-21292 11-24)

N65-21291 Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE DETERMINATION OF OSCILLATOR STRENGTHS IN ATOMIC SPECTRA
N. P. Penkin *In its* The Determination of Oscillator Strengths in Atomic Spectra. Determination of Oscillator Strengths in the Spectra of Iron and Nickel Jun. 1964 89 p refs Transl. into ENGLISH from J. Quant. Spectr. Radiative Transfer (London), v. 4, no. 41, 1964 (See N65-21290 11-24)

This paper gives an account of methods for determining absolute and relative oscillator strengths of atomic spectral lines. A new method for determining f-values, based on the simultaneous measurement of dispersion and total absorption in the spectral lines, is described. The paper summarizes the results of measurements carried out on absolute and relative oscillator strengths for lines in the spectra of elements belonging to groups I, II, and III of the Mendeleev table and of elements characterized by the building up of the 3d shell (from Sc I to Ni I). Results obtained with the aid of the hook method in a study of the processes of excitation and ionization in a low-pressure plasma ($P \leq 10$ mm Hg) are also given. Author

N65-21292 Smithsonian Astrophysical Observatory, Cambridge, Mass.
DETERMINATION OF OSCILLATOR STRENGTHS IN THE SPECTRA OF IRON AND NICKEL
G. F. Parchevskii and N. P. Penkin *In its* The Determination of Oscillator Strengths in Atomic Spectra. Determination of Oscillator Strengths in the Spectra of Iron and Nickel Jun. 1964 12 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ. (Leningrad), v. 11, no. 113, 1954 (See N65-21290 11-24)

Oscillator strengths for lines in the spectra of iron and nickel were determined by hook (anomalous dispersion) method. Spectrograms consisting of photographs of hooks for absorption lines of 14 iron multiplets were obtained. These lines, which are in the region from 2900 to 4400 Å, aris from transitions whose lower levels belong to the a^5D, a^5F, and a^3F terms of the iron atom. Photographs of hooks near absorption lines of 20 nickel multiplets were also obtained and measured. These nickel lines, which lie in the region from 3100 to 3900 Å, arise from transitions whose lower levels belong to the a^3F, a^3D, and a_1D terms of the nickel atom. Relative f-values were determined for 56 iron lines and 47 nickel lines using a relation which follows from the theory of the hook method and holds for isolated lines. Errors in the determination of f-values are discussed. Comparisons of the f-values obtained by the hook method with those obtained by the emission method and the absorption method are made, and it is concluded that determinations by the hook method yield the most reliable results. L.S.

N65-21293# Atomic Energy Commission, Washington, D. C. Div. of Reactor Development
NAVAL REACTORS PHYSICS HANDBOOK. VOLUME I: SELECTED BASIC TECHNIQUES
A. Radkowsky, ed. 1964 1561 p refs

Basic theoretical and experimental developments in reactor physics are presented, including those applicable to design of thermal and intermediate energy neutron reactors, and information of general interest is given on pressurized water

reactors. The problems of neutron slowing-down and thermalization are covered in detail. The theoretical concepts are applied to the determination of ideal reactor characteristics and extended to account for the heterogeneous and three-dimensional nature of actual reactors. After the discussion of calculation methods, the advantageous application of burnable-poison depletion characteristics is described. The discussion of reactor kinetics defines principles and methods for safe analysis. Tests are described for experimental verification of core design adequacy and reliability, and for validation of analytical models. Mathematical methods, computer characteristics, and programing methods are discussed, and major nuclear design programs for the IBM 704 and Philco 2000 computers are presented. E.P.V.

N65-21313*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

APPROXIMATION OF EXPECTATION VALUES

Joseph O. Hirschfelder and William A. Sanders 10 Mar. 1965 9 p refs

(Grants NsG-275-62; NsG-512)

(NASA-CR-57909; WIS-TCI-84) CFSTI: HC $1.00/MF $0.50

The general problem of calculating expectation values for properties other than energy by the use of perturbation theory is considered. Author

N65-21352*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

SELF-CONSISTENT FIELD SCHEMES FOR THE TWO-ELECTRON ATOMIC IONS IN THE GROUND STATE

George V. Nazaroff 8 Feb. 1965 104 p refs

(Grant NsG-275)

(NASA-CR-57894; WIS-TCI-77) CFSTI: HC $4.00/MF $0.75

The formalism for the generalized H-config ration self-consistent (SCF) schemes is developed for the two-electron atomic ions in the ground state. The equations for the SCF orbitals are expanded in powers of the inverse nuclear charge according to the well-known perturbation scheme based on considering the electronic interaction potential as a perturbation. Several first-order SCF equations are solved numerically. The first-order part of the Extended Hartree–Fock (EHF) scheme, defined as that SCF scheme which contains one correlation orbital of each angular symmetry type, is discussed in detail. The double-excitation parts of several second-order EHF energies are obtained numerically and compare very favorably with the exact values. These second-order energies are the lowest possible energies obtainable from an orbital product approximation to the double-excitation part of the exact first-order wave function. Author

N65-21373# Nihon Univ., Tokyo (Japan). Dept. of Physics

RIGID SPHERE MODEL OF ELEMENTARY PARTICLES AND THE ELECTROMAGNETIC FIELD

Osamu Hara and Tetsuo Goto [1964] 44 p refs

(NUP-64-19)

The field equation for the metric field is given by the requirement of general covariance. In the first approximation with respect to the square root of the gravitational constant, this equation reduces to the Maxwell's equation with $Q = eI^3$, where Q is the electric charge and I^3 is the third component of the isospin given by Takabayasi and Vigier in their theories of the extended particle model of elementary particles. The fact that the electromagnetic field defines a special direction in the isospace follows very naturally from this field equation. Thus, all characteristic features of the electromagnetic field as well as the relation between the electromagnetic field and the isospin are derived as a necessary consequence of the theory, without any further specific assumptions. Author

N65-21375# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research

A COMPARISON OF ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN ULTRA-HIGH ENERGY JETS WITH THE QUASI-RECTANGULAR DISTRIBUTION PREDICTED BY THE MODIFIED STATISTICAL MODEL

J. Babecki and M. Miesowicz Jul. 1964 12 p refs

(Rept.-537/VI)

Ninety ultrahigh energy jets and limited number of evaporation tracks were analyzed to compare the angular distributions of secondary particles with the quasi-rectangular angular distribution predicted by a modified statistical model with independent emission of particles. The analysis shows a very significant deviation of the observed angular distributions from the quasi-rectangular form. The deviation is of the type predicted by the fire-ball model. Author

N65-21377 European Organization for Nuclear Research, Geneva (Switzerland).

PROCEEDINGS OF THE 1964 EASTER SCHOOL FOR PHYSICISTS USING THE CERN PROTON SYNCHROTRON AND SYNCHRO-CYCLOTRON, VOLUME IV

E. H. S. Burhop, J. C. Combe, C. Franzinetti, and L. Van Hove 25 Jan. 1965 280 p refs Conf. held at Herceg-Novi, 18–31 May 1964

(CERN-64-13, Vol. IV)

CONTENTS:

1. THE WEAK INTERACTIONS OF STRANGE PARTICLES L. Van Hove p 1–50 refs
2. HIGH-ENERGY NEUTRING INTERACTIONS C. Franzinetti p 51–96 refs
3. MAGNETIC MOMENT EXPERIMENTS J. C. Combe p 97–136 refs
4. HYPERNUCLEI E. H. S. Burhop p 137–186 refs
5. OPENING AND CLOSING SPEECHES OF THE SCHOOL p 187–263 refs

N65-21395# Oak Ridge National Lab., Tenn. Neutron Physics Div.

MEASUREMENT OF α, THE RATIO OF THE NEUTRON CAPTURE CROSS SECTION TO THE FISSION CROSS SECTION, FOR ^{235}U IN THE ENERGY REGION FOR 3.25 eV TO 1.8 keV

G. deSaussure, L. W. Weston, R. Gwin, J. E. Russell, and R. W. Hockenbury (Rensselaer Polytechnic Inst.) Apr. 1965 73 p refs

(Contracts W-7405-ENG-26; AT(30-3)-328)

(ORNL-3738) CFSTI: $3.00

The value of α, the ratio of the neutron capture cross section to the fission cross section, for ^{235}U was measured over a neutron energy range extending from 3.25 eV to 1.8 keV. In addition, capture and fission cross sections were measured from 3.25 to 25 eV. A multiplate ^{235}U fission chamber, surrounded by a large liquid scintillator, was placed in the neutron beam. Gamma rays emitted when the uranium absorbed a neutron were detected with high efficiency by the scintillator, and if the absorption resulted in a fission, the fission fragments were detected by the fission chamber itself. The value of α was derived from the ratio of the count rate

of the scintillator in anticoincidence with the fission chamber to the count rate of the scintillator in coincidence with the fission chamber. Relative fission and capture cross sections were obtained from these count rates and from an auxiliary measurement of the incident neutron beam spectrum. Results are presented in graphical and tabular form. Author

N65-21414# Los Alamos Scientific Lab., N. Mex.
EXPERIMENTS ON THE REACTION $\pi + N \rightarrow \pi + \pi + N$ AT THE PROPOSED LOS ALAMOS MESON PHYSICS FACILITY
Lewis Agnew 27 Mar. 1965 29 p refs
(Contract W-7405-ENG-36)
(LA-3171-MS) CFSTI: $2.00

The pion–pion interaction is of great importance and can be investigated in the inelastic pion reaction $\pi + N \rightarrow \pi + \pi + N$. This reaction could be studied at LAMPF using at least two different experimental techniques: bubble chambers and electronic counters. A hydrogen bubble chamber can make a major contribution because it is capable of high precision and yields complete kinematics for four of the five possible inelastic reactions. Bubble chamber operation at LAMPF would be efficient because the macroscopic rep rate of 30 cps is comparable to (or greater than) expected rates for large chambers having good resolution, and because operation is fully compatible. Electronic counters are fast and versatile, and will enable low statistical errors for many data points because of the (orders-of-magnitude) more intense pion beams available at LAMPF. These intense beams will also enable the investigation of polarization effects involving the recoil nucleon. Author

N65-21438# Nihon Univ., Tokyo (Japan).
LARGE t LIMIT OF COMPTON SCATTERING OF A SCALAR PHOTON BY A SCALAR NUCLEON IN PERTURBATION EXPANSION
J. Otokozawa and H. Suura [1964] 16 p refs
(NUP-65-3)

Ladder diagrams for Compton scattering of a massless scalar photon by a scalar nucleon are evaluated in large t limit. The leading term in 2nth order is found to be $(1n\ t)^{2n-2}/t$, compared to $(1n\ t)^{n-1}/t$ for the case of scattering of two scalar particles of finite masses. In terms of partial waves, 2nth order diagram gives a leading singularity $1/(l+1)^{2n-1}$ at $l = -l$, compared to $1/(l+1)^n$ for finite mass case. Regge poles generated by summing ladder diagrams and the corresponding large t behavior are discussed. Author

N65-21467*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
SPECTRA OF GAMMA RAYS PRODUCED BY THE INTERACTION OF ~160-MeV PROTONS WITH Be, C, O, Al, Co, AND Bi
W. Zobel, F. C. Maienschein, and R. J. Scroggs Apr. 1965 76 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-62177; ORNL-3506) CFSTI: HC $3.00/MF $0.75

A measurement of the gamma rays in the energy range from 0.6 MeV to 11 MeV resulting from bombardment of Be, C, H_2O, Al, Co, and Bi targets with ~160-MeV protons was completed. A three-crystal scintillation spectrometer was used as a pair spectrometer for photons having energies above 2 MeV and as a total-absorption, anticoincidence spectrometer for photons having energies below 2.5 MeV. A time-of-flight method was used to reject counts due to neutrons, with an average rejection efficiency of 0.70 ±0.01. Data were obtained in the form of pulse-height spectra which were converted to photon spectra by a computer-programed unscrambling technique resulting in the assignment of upper and lower spectral bounds representing a 68% confidence interval. The bulk of the data was obtained at 136° from the direction of the proton beam; other data obtained with aluminum targets at 44° and 20.5° give no evidence of anisotropy. Author

N65-21527# Battelle-Northwest, Richland, Wash. Physics and Instruments Dept.
A MONTE CARLO STUDY OF HOMOGENEOUS PLUTONIUM AND URANIUM MIXTURES
L. L. Carter and C. R. Richey Dec. 1964 52 p refs
(Contract AT(45-1)-1830)
(BNWL-3) CFSTI: $3.00

Monte Carlo methods were used to calculate the infinite multiplication factor and other parameters of interest for a variety of mixtures of plutonium and uranium. These calculations were performed with the HISMC Monte Carlo computer code that samples neutron lifetimes from birth to absorption for infinite, homogeneous systems. Inelastic scattering events were assumed to be isotropic in the center of mass system with the energy loss determined from either stored transfer matrices or the statistical model. Anisotropic elastic scattering for neutron energies in excess of 0.1 MeV was also included. The second and fourth moments of the slowing down distributions were obtained from a space independent technique. Author

N65-21535# California Univ., Livermore. Lawrence Radiation Lab.
THE POPULATIONS OF BOUND STATES OF HYDROGENIC IONS IN A STEADY STATE WITH NONTHERMODYNAMIC EQUILIBRIUM
William H. Grasberger Feb. 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-12408) CFSTI: $2.00

This report treats the departures of populations of 1-electron ions from values determined by the condition of local thermodynamic equilibrium. If collisions do not occur with sufficient frequency and if the radiation field departs noticeably from that of a blackbody, the effect on the populations can be important. The concepts of kinetic equilibrium, radiative equilibrium, population invariance, cyclic line transitions, and conditions of a steady state are discussed. The energy diagram of hydrogen ions, including fine structure, hyperfine structure, and the Lamb shift, is presented. The complication of interlocking effects and coherent and noncoherent scattering are also mentioned. The condition of population invariance is derived using the principle of detailed balance and the relation between Einstein coefficients. The equation of radiative equilibrium is also examined. A simple model is proposed; and the assumptions of kinetic equilibrium, steady state, no collisional transitions, and the noncyclic case for the transitions are made. This leads to the determination of the population of a given level by the condition that the rate of radiative ionizations from the level is equal to the rate of radiative recombinations to the level. Conditions for kinetic equilibrium, for neglecting cyclical line transitions, and for neglecting collisional transitions are presented. Author

N65-21636# Los Alamos Scientific Lab., N. Mex.
MEASUREMENTS OF THE ABSOLUTE FLUORESCENCE EFFICIENCY OF AIR UNDER ELECTRON BOMBARDMENT
Paul L. Hartman (Cornell Univ.) 30 Mar. 1965 56 p refs
(Contract W-7405-ENG-36)
(LA-3147-MS) CFSTI: $3.00

Air at pressures between 10^{-1} and 10^{-2} mm Hg is excited by controlled electron beams of energies up to 1 keV. The light output is sampled as regards both geometry and spectrum, so that the total amount of light emitted and the fluorescence efficiency can be determined. The emission of the 3914-Å (0,0) band of N_2^+ is considered. Integration was done by three independent methods: by using an optical integrating sphere in which the electron energy is deposited, by sweeping a scanning detector around the glow, and by sampling the glow produced in a transparent bell jar. Calibrations are described in detail. Among the disturbing influences in the work were the perturbing effects of very slow electrons. Author

N65-21575 California Univ., Berkeley. Berkeley Astronomical Dept.

PRESSURE-DEPENDENT PARTITION FUNCTIONS AND EQUILIBRIUM CONSTANTS FOR MOLECULAR HYDROGEN

M. S. Vardya *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 5-14 refs (See N65-21575 11-30)
(Grant AF-AFOSR-171-63)

The persistence of hydrogen molecules at high temperatures and densities leads to the concept of pressure dissociation and the need of pressure- and temperature-dependent partition functions. An evaluation of such partition functions is presented. The decrease of the dissociation potential as a function of separation and the values of partial pressures of atomic and molecular hydrogen, the pressure equilibrium constant, and the energy are given as functions of the absolute temperature and the distance of separation. The approximate nature of these calculations is emphasized. E.E.B.

N65-21646*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

THERMAL FIELD EMISSION WITH A TERMINATED IMAGE POTENTIAL

James F. Morris Washington, NASA, Apr. 1965 27 p refs
(NASA-TN-D-2784) CFSTI: HC $1.00/MF $0.50

This paper develops a theory for thermal field emission with an image potential that terminates at the emitter Fermi level. The resulting equations predict currents over and through the confining potential barrier. In addition, penetration probabilities and their generating functions are tabulated for fields from 10^5 to 10^9 volts per centimeter and for all emitter Fermi levels and work functions. Results are compared with those obtained for the nonterminated image potential. Author

N65-21769*# Florida Univ., Gainesville. Depts. of Chemistry and Physics

RECENT DEVELOPMENTS IN THE METHOD OF DIFFERENT ORBITALS FOR DIFFERENT SPINS

Ruben Pauncz [1965] 12 p refs
(Grant NsG-512)
(NASA-CR-62213) CFSTI: HC $1.00/MF $0.50

Applications of the alternant molecular orbital (AMO) method are considered for nonalternant systems. The AMO is contrasted with the nonpaired spatial orbital (NPSO) method; the NPSO method seems to be more powerful when applied to small conjugated systems, whereas the AMO method is better suited to the treatment of large conjugated systems. Recent applications of the AMO method to nonalternant systems such as azulene, fulvene, and naphthalene are reviewed. Wave functions for the spatial orbitals of benzene are discussed. Results of the NPSO method seem to open a new possibility in describing and interpreting the structure of molecules. The approach is closely related to the valence-bond method. The use of different spatial orbitals in connection with different spin functions showed that a suitably chosen functional form with a small number of nonlinear variational parameters can successfully approximate a configuration interaction wave function with a high number of linear parameters. L.S.

N65-21783# California Univ., Livermore. Lawrence Radiation Lab.

POLARIZED PIONS

W. A. Perkins 9 Feb. 1965 21 p refs
(Contract W-7405-ENG-48)
(UCRL-7523) CFSTI: $1.00

The possibility that all pions have spin 1 is considered. The spin-zero assignment for charged pions is based mainly on a detailed balance argument involving the reaction $p + p \rightleftarrows \pi^+ + d$, while for the neutral pion the argument is based on its decay into two photons. It has been previously noted (1) that the detailed balance argument is invalid if the pions are completely polarized in the production reactions, and (2) that such polarization is possible only in longitudinal mode with zero spin along the direction of propagation. A particular model of the pion is discussed in which the pion is considered as a composite particle composed of two spin-1/2 particles. The particle so formed is longitudinally polarized with zero spin along the direction of propagation and exists only in this spin state. The longitudinal polarization is in agreement with the observed polarization from $\pi-\mu$ decay. The argument against a spin-1 particle decaying into two photons was also examined, but still appears valid. Some experimental implications of the theory are discussed. Author

N65-21814# Oak Ridge National Lab., Tenn. Neutron Physics Div.

MEASUREMENT OF α, THE RATIO OF THE NEUTRON CAPTURE CROSS SECTION TO THE FISSION CROSS SECTION, FOR ^{235}U IN THE ENERGY REGION FROM 3.25 eV TO 1.8 keV

G. deSaussure, L. W. Weston, R. Gwin, J. E. Russell, and R. W. Hockenbury (Rensselaer Polytech. Inst.) Apr. 1965 73 p refs
(Contracts W-7405-ENG-26; AT(30-3)-328)
(ORNL-3738) CFSTI: $3.00

The value of α, the ratio of the neutron capture cross section to the fission cross section, for ^{235}U was measured over a neutron energy range extending from 3.25 eV to 1.8 keV. In addition, capture and fission cross sections were measured from 3.25 to 25 eV. The experiment was performed with the neutron time-of-flight facilities. A multiplate ^{235}U fission chamber, surrounded by a large liquid scintillator, was placed in the neutron beam. Gamma rays emitted when the uranium absorbed a neutron were detected with high efficiency by the scintillator, and if the absorption resulted in a fission, the fission fragments were detected by the fission chamber itself. The value of α was derived from the ratio of the count rate of the scintillator in anticoincidence with the fission chamber to the count rate of the scintillator in coincidence with the fission chamber. Relative fission and capture cross sections were obtained from these count rates and from an auxiliary measurement of the incident neutron beam spectrum. Results are presented in graphical and tabular form. Author

N65-21818# Oak Ridge National Lab., Tenn.

THE EFFECT OF ACCOMMODATION ON THERMAL TRANSPIRATION: LIMITATIONS OF THE "DUSTY GAS" MODEL IN THE DESCRIPTION OF SURFACE SCATTERING

E. A. Mason and A. P. Malinauskas Apr. 1965 19 p refs
(Contract W-7405-ENG-26)
(ORNL-3796) CFSTI: $2.00

The effect of gas-surface accommodation mechanisms on thermal transpiration at very low pressures is discussed. A comparison is made between a rigorous generalized formulation, and results obtained from considerations of various types of gas-surface interaction as applied to the dusty gas model for gas transport. The types of scattering pattern considered are found to be inappropriate for use in describing the experimentally observed, low pressure, thermal transpiration anomalies. The proposal is made to account for the anomalous nature of the transpiration effect in the Knudsen region through the use of an additional experimentally determined parameter, and the effect of this alteration on equations, which were employed previously to describe the pressure dependence of thermal transpiration, is discussed. Author

N65-21844# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
RELATIVISTIC KINEMATICS OF NEW MODELS OF MULTIPLE MESON PRODUCTION AND SOME RELATED TOPICS
G. Coghen Aug. 1964 69 p refs
(Rept.-552/VI)

A review of formulas useful in the analysis of high energy events has been given, and some procedures described. Some formulas concerning the kinematics of collisions are described; angular distributions and their transformation are given; and the discussion of some multiple production models are presented. Author

N65-21849# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics
MOLECULAR DYNAMICS INVESTIGATED BY NEUTRON SCATTERING
J. A. Janik Nov. 1964 67 p refs
(Rept.-368)

Problems in connection with neutron scattering by molecules of gases and condensed states are discussed, and also the molecular dynamics of NH_4-groups in ammonium compounds, H_3O-group in H_3OClO_4, molecules of liquid and solid methane, ice, water and crystalline water, HF, KHF_2, KH_2F_3, NaH_2F_3, KH_2PO_4, K_2HPO_4, K_3PO_4 and CH_3-groups in some methyl compounds. Author

N65-21859# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Physik-Institut
EMITTER THICKNESS EFFECTS IN BETA-SPECTROSCOPY [QUELLENDICKENEFFEKTE IN DER BETA-SPEKTROSKOPIE]
I. Hofmann and H. Baier 1964 10 p refs In GERMAN Presented at the Herbsttagung der Osterreichischen Physikalischen Gesellschaft, Graz, 1964 Submitted for Publication
(SGAE-PH-13)

The beta spectrum of Na^{25} in 3.1 mg/cm^2, 1.0 mg/cm^2, and 0.02 mg/cm^2 thickness was determined by spectrometer observation. Observed nonlinear, thickness-depending distortions of the regular spectrum showed that thicker emitters pass more electrons to the entrance slit of the spectrometer than thinner sources at the same energies. A theoretical analysis of the problem was undertaken by employing a solution of the basic Boltzmann transportation equation to find the exact scattering cross section of electrons with an energy of $\lesssim$1.5 MeV for thin foils. The discrepency between the measured and the theoretical spectrum of a 3 mg/cm^2 NaCl source is attributed to the distortions by the direction scatter effect. Application of the Monte-Carlo method for multiple distribution is advised for analysis of the thickness effects of thin foils above $20<n<50$. Transl. by G.G.

N65-21878# Illinois Univ., Urbana. Dept. of Physics
SURVEY OF SOME SYSTEMATIC PROPERTIES OF THE NUCLEAR E1 TRANSITION PROBABILITY
Charles-Fs. Perdrisat [1965] 127 p refs
(Contract AF 49(638)-1048)
(AD-613472)

Common properties of nuclear electric dipole transition (E1) probabilities are discussed, and compared to nuclear model predictions. The single-particle estimate for the electromagnetic transition probabilities is summarized. A classification of the E1 transitions with measured rate as a function of the kind of nucleus and levels involved is proposed. A detailed discussion of experimental data and of the relevant nuclear models on transitions in odd-A spherical nuclei, even-A spherical nuclei, odd-A deformed nuclei, and in even-A deformed nuclei is given. A further breakdown is made for each, according to the kind of levels between which E1 transitions proceed. The possible theoretical descriptions of the levels not predicted by the simple shell model are emphasized. L.S.

N65-21920# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
ON THE EXISTENCE OF EVENTS WITH LARGE ENERGY TRANSFER INTO NEUTRAL PIONS IN THE INVESTIGATION OF NUCLEAR INTERACTIONS AT MOUNTAIN ALTITUDES
Z. Buja, B. Heller, J. Massalski, and B. Niziol Nov. 1964 32 p refs
(Rept.-551/VI)

The experimental data were obtained using an apparatus of an area of 10 m^2 installed at 3200 m above sea level. The apparatus contained a few layers of emulsion plates and ionization chambers separated by lead and graphite absorbers. Nuclear interactions in which the neutral pions carry away a large fraction $/k_{\pi^0}/$ of the primary energy were discussed. The observed interactions are not inconsistent with the fireball model, but events with $k_{\pi^0}>0.6$; it must be assumed that the most energetic pion comes from the excited baryon decay. Author

N65-21923# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics
MAGNETIC PROPERTIES OF STRONGLY DEFORMED NUCLEI [WLASNOSCI MAGNETYCZNE SILNIE ZDEFORMOWANYCH JADER ATOMOWYCH]
Stanislaw Ogaza Dec. 1964 56 p refs In POLISH; ENGLISH summary
(Rept.-362)

An analysis of all available experimental data on magnetic properties of deformed nuclei in the region $150<A<190$ is performed. It appears that with pairing correlations included, the theoretical rotational g-factors are in good agreement with the experimental g_R-values, especially for even-even nuclei. Taking into account for odd-A nuclei, the spin polarization of the even-even core by the odd particle, a satisfactory agreement of experimental and theoretical values for the intrinsic g-factors, g_K, is obtained. Author

N65-21936 United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.

A SYSTEMATIC APPROACH TO THE EVALUATION OF CHAIN MEMBER YIELDS IN RADIOACTIVE DECAY CHAINS

I. S. Mc Gill Nov. 1964 20 p

(AERE-M-1464) HMSO: 3s 6d

A calculation procedure is developed, readily amenable to computer programing, for the calculation of the chain member yields in radioactive decay chains, or in the analogous isotope production chains for isotope production by neutron absorption. The calculation procedure entails only the systematic repetition of a number of simple arithmetical operations on two triangular arrays of numbers, which are readily derived from the decay constants of the production chain members. After calculation of chain member yields for some time interval T, the addition effort required in calculating the yields at any integral multiple of T is minimal as is the effort in repeating the calculation for a series of different initial concentrations. A Fortran program based on the calculation method is described. Author

N65-21950 United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.

A COMPILATION OF EXPERIMENTAL AND THEORETICAL NEUTRON SPECTRA

R. H. Jones, ed. Nov. 1964 67 p refs

(AERE-R-4776) HMSO: 9s

Experimental data on neutron spectra in various moderating assemblies are made available for testing methods of calculating spectra; calculations using theoretical models are included for reference. Data were obtained from moderating assemblies using neutrons from a 27-MeV electron linear accelerator. Neutron energies were determined by the time-of-flight method with either the pulsed source or neutron chopper method employed for pulsing the neutrons. Double logarithmic graphs show spectra for different levels of neutron energy for each moderator assembly. In the moderator assemblies either water, deuterium oxide, or graphite were used as moderator, with copper, boron, cadmium, or plutonium as absorber element in boric acid or nitrate solution or in sheet form. The same moderators were used in the theoretical systems, with various specified scattering kernels. The neutron balance equation (solved iteratively on a computer) for determination of the theoretical spectra is shown. J.M.D.

N65-22041# Princeton Univ., N. J. Elementary Particles Lab.

EXPERIMENTAL MEASUREMENT OF THE ELECTROMAGNETIC FORM FACTOR OF THE NEGATIVE π MESON

Technical Report, Jun. 1962–Dec. 1965

David G. Cassel (Ph.D. Thesis) 10 Feb. 1965 79 p refs

(Contract Nonr-1858(06))

(TR-37; AD-457811)

The scattering of π mesons of 21-BeV energy, incident on electrons at rest was studied in order to determine the electromagnetic form factor of the π meson. The results of an analysis of 4% of the data obtained in the experiment are consistent with a point charge model for the π meson. The data place an upper limit on the root mean square radius due to charge structure effects and radiative effects of R = 3.3 f. This limitation on the radius is to be interpreted as a limitation on the absolute value of the slope of the form factor at t = 0. These data do not exclude positive slopes at the origin corresponding to an imaginary value of the radius of the same magnitude. Author

N65-22042# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering

ELECTRICAL RESISTIVITY OF SUPERCOOLED GALLIUM

Progress Report, Aug. 1, 1964–Feb. 28, 1965

George A. Colligan and John M. Lo Mar. 1965 63 p refs

Extracted in part from a thesis by John M. Lo

(Contract Nonr-3897(01))

(SCP-2; AD-457915)

Transport measurement by means of electrical resistivity is used to determine structural changes in supercooled gallium. The results are interpreted in the light of clustering phenomena deduced by McLaughlin and Ubbelohde from viscosity data of tin. The change in electrical resistivity of gallium with increased supercooling is found to be linear. From this, an estimate of the upper bound of cluster size is deduced. The rate of increase in cluster concentration is also deduced to level off with increased supercooling. Author

N65-22126*# Western Reserve Univ., Cleveland, Ohio.

BETA DECAY OF Rb^{86}

Richard H. Thompson and Karl J. Casper [1963] 18 p refs

(Grant NsG-655)

(NASA-CR-62339) CFSTI: HC $1.00/MF $0.50

The beta decay of Rb^{86} was measured using lithium drifted surface barrier silicon detectors. Corrections to the spectrum were made using the measured response function of the detectors. The inner branch has an allowed spectral shape and an endpoint energy of 677 ±5 keV, and the outer branch has a first forbidden unique spectral shape and an endpoint energy of 1753 ±4.5 keV Author

N65-22161# Radiation Research Associates, Inc., Fort Worth, Tex.

UTILIZATION INSTRUCTIONS FOR GENERAL APPLICATION OF THE LO5 MONTE CARLO PROCEDURE

D. G. Collins 29 May 1964 146 p refs

(Contract DA-49-146-XZ-254)

(RRA-T44; AD-612031)

Instructions for the utilization of LO5, a Monte Carlo procedure performing neutron and gamma-ray penetration and scattering calculations on the IBM-7090, have been rewritten to clarify and add detail to the previous instructions. The revised utilization instructions apply to the original LO5 code as well as to the RRA version of LO5 which has been modified to enhance its applicability to general shielding calculations. A description of the principal mathematical relations used by the code in the solution of neutron and gamma-ray transport problems is included. Detailed definitions and formats for the input data which comprise problem deck and the energy and element library decks are given. In addition, peculiarities in the input data requirements discovered in extensive use of the code are discussed. General operational information for running the code on the IBM-7090 are also given. Author

N65-22178*# Texas Univ., Austin. Dept. of Physics

SOME FIRST-ORDER PERTURBATION ENERGY VALUES

Frank Sanders and Charles W. Scherr [1964] 5 p

(Grant NsG-263-62)

(NASA-CR-56809) CFSTI: HC $1.00/MF $0.50

In the conventional perturbation study of the two-electron atom the perturbation is chosen to be the electron–electron interaction term in the potential energy

$$H = H_0 + Z^{-1}r_{12}^{-1}$$

where H_0 is the zero-order Hamiltonian with eigenfunctions Ψ_{0p}, for instance, and Z is the nuclear charge. Then the first-order perturbation energy correction is given by

$$\epsilon_1(p) = \int d\tau\ \Psi_{0p}^* \Psi_{0p}/Zr_{12}.$$

In this report, the $\epsilon_1(p)$ are computed for a number of the singly excited singlet and triplet S, P, and D symmetry states of the helium isoelectronic sequence. A singly excited state is one whose correct zero-order wave function is of the form of a properly symmetrized product $\Psi_{0p} = \Psi_{100}(1)\ \Psi_{n/m}(2)$ where the $\Psi_{n/m}$ are the hydrogen problem eigenfunctions. These ϵ_1 values are needed for the calculation of the higher order energy coefficients. Author

N65-22207*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
ON THE THERMAL ENERGY TRANSFER BETWEEN FREE ELECTRONS AND MOLECULAR VIBRATION
I. R. Hurle Jun. 1964 47 p refs Submitted for Publication
(Contract NASr-109)
(NASA-CR-56817) CFSTI: HC $2.00/MF $0.50

Thermally averaged probabilities for the electron deexcitation of the first vibrational level in N_2 are calculated from the discrete velocity-dependent collision cross sections measured by other workers. The results are presented for the electron temperature range 1000° to 5000° K. Over this range the probability is found to have an empirical temperature dependence of the form $AT^{-1.8}\exp(T^{1/3})$, with $A = 1.58 \times 10^{-3}$. The probability increases from 10^{-4} at 1000° K to 10^{-2} at 5000° K. By comparison, the corresponding experimental probabilities for the deexcitation of N_2 vibration by nitrogen molecules are 10^{-8} at 1000° K and 3×10^{-4} at 5000° K. These figures imply that in some circumstances an electron concentration of only 1 in 3×10^6 could have the normal nitrogen molecular relaxation time at 1000° K, and that a concentration of 1 in 6×10^3 could do so at 5000° K. Existing spectrum-line reversal measurements of N_2 vibrational relaxation carried out in nozzle-expansion flows in the presence of small amounts of easily ionized Na and Cr atoms are reviewed in the light of these findings. It is shown that the electron concentrations in these experiments were too low to have significantly influenced the relaxation measurements. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-21162*# Minnesota Univ., Minneapolis. Heat Transfer Lab.
THERMAL ANALYSIS OF ANODE AND CATHODE REGIMES IN AN ELECTRIC ARC COLUMN Quarterly Progress Report No. 7, Jan. 1–Mar. 31, 1965
E. Pfender, S. Wutzke, G. Gruber, and E. R. G. Eckert 15 Apr. 1965 22 p
(Contract NAS3-2595)
(NASA-CR-54121) CFSTI: HC $1.00/MF $0.50

The behavior of the arc was studied over a wide range of parameter settings. Oscillograms of results under varying conditions are reported. The oscillograms show that the total current remains constant despite arc fluctuations. This seems to be due to the characteristics of the power supply which exhibits a high inductive impedance. Therefore, no sudden current change is possible and the restriking of the arc shows up only as a sudden voltage drop. The time required for breakdown in all cases was 80 ± 40 microseconds. It was assumed that the voltage between the plasma column and an anode segment led to the development of electron avalanches which finally caused the breakdown. Also, new symmetrical double anode assembly and a cylindrical anode assembly were designed and constructed. E.E.B.

N65-21233# Atomic Energy Commission, Oak Ridge, Tenn.
PLASMA DIAGNOSTICS, COLLECTION OF ARTICLES
B. P. Konstantinov Dec. 1964 279 p refs Transl. into ENGLISH of the Publ. "Diagnostika Plazmy, Sbornik Statei" Moscow, Gos. Izd. Lit. Po At. Nauke i Tekhn., 1963 299 p
(AEC-TR-6518) CFSTI: $6.00

CONTENTS:
1. SPECTROSCOPIC METHODS OF INVESTIGATING A PLASMA p 3–64 refs
2. MICROWAVE METHODS OF INVESTIGATING PLASMA p 65–145 refs
3. CORPUSCULAR METHODS OF PLASMA RESEARCH p 146–217 refs
4. PROBING, BOLOMETRIC, AND OTHER METHODS OF INVESTIGATING A PLASMA p 218–273 refs

N65-21234# Atomic Energy Commission, Oak Ridge, Tenn.
PLASMA PHYSICS AND PROBLEMS OF CONTROLLED NUCLEAR FUSION [FIZIKA PLAZMY I PROBLEMY UPRAVLYAEMOGO TERMOYADERNOGO SINTEZA]
N. I. Nazarov et al Oak Ridge, Tenn., AEC, 12 Feb. 1965 452 p refs Transl. into ENGLISH of Dokl. Vtoroi Konf. po Fiz. Plazmy i Probleme Upravlyaemogo Sinteza, Khar'kov, 14–19 Nov. 1960 Kiev, Izd. Akad. Nauk Ukr. SSR, 1963 344 p
(AEC-TR-6527) CFSTI: $7.56

CONTENTS:
1. HIGH-FREQUENCY CHARACTERISTICS OF PLASMA p 1–113 refs
2. INTERACTION OF BEAMS OF CHARGED PARTICLES WITH PLASMA AND THE PROBLEM OF STABILITY OF PLASMA p 114–237 refs
3. MAGNETOHYDRODYNAMICS AND SHOCK WAVES IN PLASMA p 238–284 refs
4. INVESTIGATION OF PLASMOIDS p 285–357 refs
5. MAGNETIC TRAPS p 358–384 refs
6. GAS DISCHARGE. TECHNIQUE OF STRONG PULSED CURRENTS p 385–410 refs
7. PLASMA DIAGNOSTICS p 411–446 refs

N65-21316*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Research Lab.
AN X-BAND WAVEGUIDE CELL FOR STUDY OF MICROWAVE PROPAGATION THROUGH MAGNETOPLASMA Technical Report No. 16
J. H. Noon, E. H. Holt, and J. F. Reynolds Nov. 1964 19 p refs
(Grant NsG-48-60)
(NASA-CR-57969) CFSTI: HC $1.00/MF $0.50

A metal X-band waveguide cell developed for studying microwave propagation through plasmas immersed in a longitudinal magnetic field consists of a length of circular waveguide mounted between turnstile junctions. Modification of these junctions permits the installation of discharge electrodes on the magnetic field axis. No glass cell is required. The discharge can be operated successfully at pressures in the range 0.25

to 1 torr. Measurements of the change in the amplitudes of the circular components of the wave polarization due to the presence of a magnetoplasma in the cell, allow calculation of electron density electron collision frequency. Author

N65-21325*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Research Lab.
PLASMA DIFFUSION AS AN INITIAL VALUE PROBLEM
D. A. Huchital and E. H. Holt Dec. 1964 56 p refs
(Grant NsG-48-60)
(NASA-CR-57955; TR-15) CFSTI: HC $3.00/MF $0.50

In describing the diffusion of a rectangular pulse of plasma in a background neutral gas the diffusion equation $\delta N/\delta t = D \nabla^2 N$ predicts the instantaneous appearance of plasma particles at an arbitrary distance from their initial position. By considering the problem from the moments of the Boltzmann equation it is shown necessary in deriving a diffusion equation to take particle inertia into account. An integral solution of the resulting equation is obtained, and interpreted as implying that the flow to an arbitrary point in space consists of particles which stream through the background gas and those that suffer a collision in transit. The problem is also discussed by expanding the distribution function into symmetric and antisymmetric parts and solving the Boltzmann equation as an initial value problem. The result can be integrated to yield the solution for the spatial and temporal development of any of the macroscopic variables. Author

N65-21376# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
THE OPTIMALIZATION OPERATIONAL CHARACTERISTICS OF A PLASMA ASSEMBLY WITH COAXIAL PLASMA GUN
S. Chvashchevski Oct. 1964 16 p refs In RUSSIAN; ENGLISH summary
(Rept.-558/IX-A)

To obtain fast and short plasmoids in a coaxial plasma gun, the gas volume introduced into the gun and the time delay of the discharge start were varied. The maximum density of the detected plasmoids of directional velocity 1.3×10^7 cm/sec was observed. In this condition the electron temperature, measured by a double probe, was 20.8 eV, and the ion density was 1.5×10^{11} ions/cm^3. The pulse characteristics of the plasma radiation was investigated by means of a photo-telescope. Author

N65-21381# Sandia Corp., Albuquerque, N. Mex.
SPECIAL MATERIALS TESTS FOR THE HYPERSONIC PLASMA GENERATOR
K. J. Touryan Mar. 1965 13 p refs
(SC-RR-65-54) CFSTI: $1.00

Cesium- and copper-impregnated tungsten emitters were tested in the 160-kW plasma jet to study: the effects of nose cone seeding upon the power output of a dc-generator utilizing the thermionic emission from a nose cone and the kinetic energy of the shock-generated plasma; and the cooling effectiveness of copper evaporation upon emitter surfaces. Nose cone seeding gave an increase in generator output by a factor of two. The tests of emitter materials also included a set of carbide emitters. Of the emitter surfaces tested, hafnium carbide showed the best heat resistance, and the ZrC-coated collector registered 40 Wt/in.^{2} output in 80%N−20%O plasma arc-jet. Author

N65-21453# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
INELASTIC ATOMIC COLLISIONS IN PLASMAS
S. N. Milford [1963] 33 p refs
(GRD-110)

The excitation and ionization collisions involving electrons, atoms, and ions at thermal and near thermal energies are discussed. The theory of electron collisions is outlined as a guide to various approximate atomic collision theories; and the current situation with the ground state and excited states of hydrogen is considered. Further, electron collisions with the rare gases, alkali metals, nitrogen, and oxygen atoms, and with helium, neon, and nitrogen ions are reviewed. Heavy particle collisions and the theory of electron collisions with hydrogen atoms are also examined. E.E.B.

N65-21463*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Research Lab.
MICROWAVE MEASUREMENT OF THE PROBABILITY OF COLLISION OF LOW ENERGY ELECTRONS IN NITROGEN Technical Report No. 17
J. H. Noon, E. H. Holt, and J. P. Quine Nov. 1964 19 p refs
(Grant NsG-48)
(NASA-CR-62184) CFSTI: HC $1.00/MF $0.50

The probability of collision for momentum transfer (P_c) of low-energy electrons (< 1 e V) in nitrogen has been experimentally determined using microwave transmission techniques. A bakeable cell constructed of X-band waveguide contained the plasma. A nitrogen discharge was produced by a pulsed dc supply and the phase shift and attenuation of the microwave signal measured as a function of time in the afterglow plasma. The change in electron temperature with time was monitored using a gated microwave radiometer. Assuming a Maxwellian velocity distribution for the electrons, P_c was calculated as a function of electron energy, and values obtained agree with those of Phelps et al but disagree with those of Anderson and Goldstein. However, the radiometer measurements indicate that the electron energy distribution is not Maxwellian in the early afterglow. This is important in explaining the disagreement between values of P_c calculated by earlier workers and in understanding the heating effect of nitrogen metastables in the afterglow. Author

N65-21472*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF INSTABILITIES AND TRANSITION TO TURBULENCE IN A LINEAR HALL ACCELERATOR
R. V. Hess, J. Burlock, B. Sidney, P. Brockman, and R. H. Weinstein May 1964 29 p refs Presented at the 5th Symp. on the Eng. Aspects of Magnetohydrodyn., Cambridge, Mass., 1–2 Apr. 1964
(NASA-TM-X-51703) CFSTI: HC $2.00/MF $0.50

The instabilities and the transition to turbulence in a well-defined crossed-field geometry were studied. Special emphasis was given to the range of operating conditions where the mean free path ranges from values smaller than, to values of the order of or larger than, the dominating wavelength of the instability. Magnetic field and pressure as transition to turbulence; criteria for transition to turbulence; effect of transition to turbulence on Hall current; effect of transition on variation of electric with magnetic field; theory of instabilities; mechanisms for transition to strong and weak turbulence at high and low densities; and the instabilities for Hall accelerators using magnetic nozzle effects are discussed. Also, the hollow cathode arc jet for plasma injection is described. E.E.B.

N65-21501 Stanford Univ., Calif. High Energy Physics Lab.
QUASI-FREE ELECTRON-PROTON SCATTERING IN H^3 AND He^3
Arne Johansson [1964] 14 p refs
(Contract Nonr-225(67))
(HEPL-326; AD-610055)

Measurements wese made of the cross sections of coincidences between scattered electrons and ejected protons, when targets of H^3 and He^3 are bombarded with 550-MeV electrons. The variation of the cross section with proton angle and proton energy was studied for fixed electron angle and energy. The results are compared with theoretical calculations based on different three-body nuclear wave functions. Author

N65-21621# Atomic Energy Commission, Washington, D. C. Div. of Research
SUMMARIES OF THE USAEC RESEARCH PROGRAM ON CONTROLLED THERMONUCLEAR REACTIONS
Mar. 1965 68 p refs
(TID-4005(Pt. 5)) CFSTI: $3.00

Summaries are given showing project objectives and status of the research, for the following classes: experimental hot plasma studies, experimental cold plasma studies, theoretical plasma studies, cross sections, vacuum and wall studies, diagnostic techniques, and cryogenics. G.G.

N65-21629*# National Aeronautics and Space Administration, Washington, D. C.
ELECTROMAGNETIC EFFECTS IN THE NEIGHBORHOOD OF AN ARTIFICIAL SATELLITE OR A SPACECRAFT MOVING THROUGH THE IONOSPHERE OR INTERPLANETARY SPACE [OB ELEKTROMAGNITNYKH EFFEKTAKH V OKRESTNOSTI DVIZHUSHCHEGOSYA V IONOSFERE ILI MEZHPLANETNOY SREDE ISKUSSTVENNOGO SPUTNIKA ILI KOSMICHESKOGO KORABLYA]
Ya. L. Al'pert Apr. 1965 58 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 3–31
(NASA-TT-F-9318) CFSTI: HC $3.00/MF $0.50

The effects arising in the neighborhood of a body moving through the ionosphere or the interplanetary medium, and the nature of their variation with growing distance between the body and earth are discussed. Results of theoretical calculations of different disturbances examined are: variation in the concentration and flux of particles; potential of the body; scattering; electrical field; excitation of longitudinal plasma waves; and evaporation. Certain published experimental findings on these effects are utilized. Author

N65-21647*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE ESCAPE OF CHARGED PARTICLES FROM A PLASMA IN A MAGNETIC FIELD [DOSLIDZHENNYA VIKHODU ZARYADZHENYKH CHASTINOK Z PLAZMI V MAGNITNOMU POLI]
L. L. Pasichnyk and O. V. Kozak Apr. 1965 12 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 7, no. 11, 1962 p 1165–1170
(NASA-TT-F-169) CFSTI: HC $1.00/MF $0.50

The emergence of charges from a hot-cathode plasma under low pressure in a magnetic field was discussed, and the spectrum of high frequency oscillations (0.02 to 30 Mc/sec) generated by the discharge was investigated. The generated electromagnetic oscillations were studied by means of a testing coil wound around the discharge tube. The signal from the coil arrived at the input of a noise-spectrum analyzer by means of which visual observations of oscillations in the 20-kc/sec to 30-Mc/sec range were made. The dependence of the ion current of the cylindrical probe on the magnetic field at a distance of 16 mm is given. It was observed that an increased emergence of charges from the plasma is always accompanied by the generation of electromagnetic waves. Comparison of the dependency on the magnetic field of oscillation intensity and probe current showed that the intensity of oscillations was closely connected to the expansion of the plasma column. E.E.B.

N65-21690# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
FOCUSSED MICROWAVE SYSTEMS FOR PLASMA DIAGNOSTICS
A. I. Carswell and C. Richard Dec. 1964 183 p refs
(Contract PD 69-400007)
(RR-7-801-32)

The usefulness of focused microwave beams for plasma diagnostics is investigated both theoretically and experimentally. Scalar diffraction theory is used to describe the amplitude and phase behavior of a microwave beam in the focal region of a lens system, and simplified expressions for the beam properties are presented in terms of an effective beam width, W, and depth of field, D. Dielectric lenses are used to produce focused microwave beams at 10 and 35 Gc/sec, and the properties of the laboratory systems are compared with the theoretical predictions. The dependence of the focal properties on such parameters as lens illumination, microwave frequency, lens F-number, and image position are studied in some detail. The properties of a double lens system for multiple focused beam plasma diagnostics are also described. The limitations of focused beams for quantitative measurements of plasma properties are discussed. Author

N65-21774*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
A MAGNETOGASDYNAMIC POWER GENERATION STUDY First Quarterly Progress Report
Fredrick H. Shair 20 Nov. 1964 40 p refs
(Contract NAS3-6260)
(NASA-CR-62229) CFSTI: HC $2.00/MF $0.50

An expression for the seed concentration which gives rise to the maximum electrical conductivity in a slightly ionized nonequilibrium plasma is derived. Various equilibrium gas systems at the optimum seed mole fraction are compared with pure alkali metal vapors. A typical plot obtained for optimum seed concentrations vs temperature for an argon–cesium plasma is given. During these experiments the seeding mole varied (probably about some mean value such as the optimum value); the influence of such variations upon the conductivity can be determined from a plot of σp vs X_o. It was decided that it is safer to overseed than to underseed because a variation of σ_p due to fluctuations in X when $X < X_o$ is much larger than when $X > X_o$. Calculations were performed to determine the maximum temperature depression due to seeding, noting vaporization, heat of seed gas, ionization, and resonance radiation loss. Preliminary calculations of electron-beam efficiencies indicated the maximum possible power increase as a function of energy imparted to the working fluid from the electron beam. R.W.H.

N65-21788# Nihon Univ., Tokyo (Japan). Dept. of Physics
ANNUAL REPORT, 1965
H. Suura [1965] 71 p refs
(NUP-65-4)

Research activities in plasma physics, solid-state physics, and theoretical low and high energy nuclear physics are discussed. Abstracts pertaining to the following topics are included: The properties of high temperature plasmas produced by the theta pinch of a slow rising magnetic field; radio frequency oscillations in a magnetoplasma; perturbation treatment in the theory of transport properties of plasmas; space charge effect on the acceleration of semirelativistic electrons in a theta pinch; theoretical investigations of the magnetohydrodynamical nature of a plasma flow in a magnetic channel; optical properties of graphite; physics underlying type II and type III superconductors and the mechanism of superconducting magnets; theory of elementary particles; quantum field theory; and low energy nuclear physics. Also discussed are the history of physics, and the institutional history of science in modern Japan. G.G.

N65-21866# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART I: ARCS AT ATMOSPHERIC PRESSURE IN ANNULAR GAPS
V. W. Adams London, Min. of Aviation, Jun. 1963 37 p refs
(RAE-TN-AERO-2896)

An experimental study is described of the motion and electric properties of a dc arc moving round an annular gap under the action of a magnetic field. The dependence of the motion on the arc current, magnetic field, and gap width is given for values up to 750 A, 940 G, and 3.2 cm, respectively. The electrical characteristics of a fixed current arc are given for fields up to 940 G. Photographic evidence of the arc rotation, together with an indication of the shape of the conducting path, is also included. Author

N65-21883# California Univ., Livermore. Lawrence Radiation Lab.
CONTROLLED THERMONUCLEAR RESEARCH Semiannual Report, Jul.–Dec. 1964
[1964] 158 p
(Contract W-7405-ENG-48)
(UCRL-12303)

The Astron accelerator was intensely operated, and demonstrated trapping and confining single pulses of electrons. At the end of the period, the Astron was disassembled for modifications. The 2X multiple compression mirror machine was also tested. It is now being reassembled with added features to reduce substantially the rate of loss of hot plasma by charge exchange, and to provide a much longer plasma lifetime. The Alice machine with a 12-bar (dodecapole) stabilizing field was also briefly operated. In the toroidal confinement program, a new form of $\int dl/B$-stable field configuration was discovered. Improvements in the use of the Homopolar device for the plasma research program were made, and plasma decay studies are in progress. Calculations on the problem of energy loss and bunching in the Astron injection process were carried out, and controlled fusion atomic and molecular processes are being investigated. Engineering developments on the various accelerators are discussed. L.S.

N65-21926# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Philips Research Labs.
THE INTERACTION OF MICROWAVES WITH THE CATHODE FALL AND NEGATIVE GLOW IN A GLOW DISCHARGE
P. J. W. Severin (Thesis - Utrecht Univ.) [1965] 95 p refs *Its* Res. Repts. Suppl. No. 2

Starting from the often measured linear electric field in the cathode fall of a glow discharge, the motion of electrons and ions is described. The electron-distribution function is treated by means of a simple model and the result is tested with the aid of the Boltzman equation; the velocity of the ions in a uniform field of arbitrary strength is discussed and the equations found are modified to make them apply to the case of a strong linear field. The perturbations in the motion of ions and electrons, caused by an extra ac voltage in the rf region, are derived; theory and experiment show good agreement. The nonlinear response of the electron motion on an extra ac field of microwave frequency is calculated; the experiments showing this effect are discussed at some length. Finally, the influence of microwave radiation on the optical spectrum emitted by the glow is investigated; for He, He_2, Ne and A quenching has been found to a degree depending on the spectral line considered. The suggested explanation of this effect is based on the form of the cross section as a function of the kinetic energy of the incident electron for excitation from ground or metastable levels. Author

N65-21935 United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
THE CENTRAL REGIONS OF THE DIFFUSE PINCH
M. G. Rusbridge Oct. 1964 19 p refs
(CLM-R-41) HMSO: 2s 6d

The structure and properties of the central regions of cylindrical diffuse pinch configurations are investigated in general terms using an expansion in powers of the radius. The discussion is then limited to discharges marginally stable to the Suydam criterion near the center. The evolution with time of the central regions due to dissipative processes such as ohmic heating and thermal conduction is discussed. It is shown that under some conditions the discharge will instantaneously become unstable. When dissipative processes are neglected, the discharge can change only if the boundary conditions change, and the influence of these changes on the central regions is discussed. The results are relevant to the problem of setting up such a configuration in a time short compared with typical diffusion times. Finally the possibility is investigated of using the results, which strictly refer only to the central regions, as a guide in constructing models of the whole discharge. As an example a particular configuration is constructed which is hydromagnetically stable and contains a pressure giving a β of 35%. Author

N65-21947 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
A PULSED ARC FOR THE STUDY OF THERMAL SHOCK
R. C. Mc Vickers and R. A. Dugdale Oct. 1964 30 p refs
(AERE-R-4748) HMSO: 5s

A low pressure pulsed carbon arc is described which gives transient heat fluxes sufficiently intense to produce surface damage on ceramic materials. To achieve an accurate and convenient waveform with simple equipment, an exponential heat pulse waveform was chosen. The time constant is 425 μs and peak power loadings from 10 to 70 kW/cm^2 can be achieved. The heat pulses delivered to a specimen placed in the arc vary slightly with position. An experimental study of peak surface temperatures on various specimens in a specified position is used to calibrate the heat fluxes. The arc characteristics are described. Radiation densities have been measured with a thermopile and the spectral distribution in the visible region has been examined. It is concluded that heating of a specimen due to absorption of radiation will be small compared with

that by conduction from the plasma. Due to contamination from the electrodes, the arc is mainly suitable for operation in air at a pressure of 1.0 torr but it has also been used regularly at 5×10^{-2} torr at low operating voltages. Author

N65-22122# Los Alamos Scientific Lab., N. Mex.
SCYLLA THETA-PINCH EXPERIMENTS: STATUS, PLANS, AND PROPOSAL FOR A CLOSED TOROIDAL THETA PINCH (SCYLLAC)
W. E. Quinn, F. L. Ribe, W. B. Riesenfeld, G. A. Sawyer, and J. L. Tuck 20 Apr. 1965 112 p refs
(Contract W-7405-ENG-36)
(LA-3289-MS) CFSTI: $4.00

The Scylla theta-pinch program initiated in 1957 has developed into the present Scylla IV experiment, utilizing 3.5-MJ energy storage, and producing a plasma of density 2×10^{16} ions/cm^3, electron temperature 300 eV, and mean ion energy 3 to 8 keV. Loss of plasma from the ends of the system limits plasma confinement of the system to a few microseconds in the present experiments. A proposed new theta-pinch experiment (Scyllac) in closed toroidal geometry will eliminate end losses. However, it is necessary to add additional longitudinal windings to stabilize the plasma against the radial outward drift introduced in toroidal geometry. The theoretical stability of the toroidal plasma geometry is examined, and feasible containment systems are found. In addition, a feasibility study shows that a theta-pinch pulsed system would be practical for a power-producing reactor if the basic problems of plasma physics were solved. Author

N65-22193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEMICLASSICAL CALCULATION OF INELASTIC CROSS SECTIONS FOR ELECTRON–CESIUM ATOMIC COLLISIONS
John W. Sheldon and John V. Dugan, Jr. 17 Apr. 1964 7 p refs Submitted for Publication
(NASA-TM-X-51736) CFSTI: HC $1.00/MF $0.50

The semiclassical inelastic cross sections for various inelastic processes are obtained as a function of the incident electron energy using the theory of Gryzinski. Expressions are given for the electron-induced 6S to 6P cesium excitation; the total excitation, which is the sum of all electron-induced excitations in cesium below the ionization potential; and the electron-induced ionization of cesium in the 6P excited state cross sections. Also, the cross section for the collision of an electron with an alkali atom which will excite the outer electron of the atom as given by Gryzinski, and the simple ground state ionization cross section are included. E.E.B.

N65-22196*# Stanford Univ., Calif. Microwave Lab.
LOW–FREQUENCY IMPEDANCE CHARACTERISTICS OF A LANGMUIR PROBE IN A PLASMA Internal Memorandum
F. W. Crawford and R. Grard Feb. 1965 30 p refs
(Grants NsG-174-61; NSF GP-936)
(NASA-CR-62131; ML-1294) CFSTI: HC $2.00/MF $0.50

Measurement of the low-frequency impedance of a Langmuir probe in a plasma can give the local electron density and temperature. Such diagnostic methods have been employed in ionospheric probing, but the interpretation of the results based on simplified theory has not been entirely satisfactory. This paper describes laboratory plasma studies designed to investigate the validity of the simplified theory. Good agreement is obtained between results obtained by two different impedance techniques, and conventional Langmuir probe data reduction. It is concluded that the methods could provide additional methods of measurement in laboratory plasmas, with some inherent advantages, but that a more detailed theory and extensive experimental verification are required before they can be applied with confidence to more complicated conditions in the ionosphere. Author

N65-22201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GENERATION OF A PLASMA IN A MAGNETIC MIRROR GEOMETRY
Roman Krawec, George M. Prok, and Clyde C. Swett 16 Jun. 1964 5 p Submitted for Publication
(NASA-TM-X-51798) CFSTI: HC $1.00/MF $0.50

An electron-bombardment technique employing a thermally emitting cathode to produce a plasma in a magnetic mirror geometry is presented. A hydrogen plasma with an ion density of 8.5×10^{11} ions/cc at a pressure of 2.2 microns of Hg 90 inches downstream from the cathode was produced by this method. This ion density is an order of magnitude larger than that obtained with a previous Penning-type discharge. In addition, the following advantages were noted: (1) The cathode was located outside the magnetic mirror to provide maximum plasma length for experiments. (2) Fabrication and installation were simple. (3) The technique is reliable and the cathode had long life under intermittent operation. (4) The plasma column was at least 1 1/2 inches in diameter under the RF coil. Electron density as a function of magnetic field, beam current, pressure, and position of the anode was measured with an 8-mm microwave interferometer. Results were relatively insensitive to the axial anode position. The effect of the magnetic field on the electron density with a beam current of 15 amperes, pressure of 2.2 microns Hg, and magnetic field of 6 kilogauss is shown. E.E.B.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-21220 Library of Congress, Washington, D. C. Aerospace Technology Div.
RADIATION DEFECTS IN GERMANIUM FROM NEUTRON BOMBARDMENT
S. Hibben *In its* Foreign Sci. Bull., Vol. 1, No. 3, Mar. 1965 p 9–13 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

A recent series of neutron bombardment tests on germanium crystals is reviewed. Both n- and p-type Ge were used, and exposure to reactor flux as well as to selected monoenergetic bombardments was employed. Interest was centered on the resultant radiation defect energy spectrum and how it was affected by different annealing procedures. A comparison is made of the defect energy spectra as determined from the Hall coefficient, and from photoconductivity spectrum measurements. Annealing is shown to occur in discrete stages, in which donor or acceptor annealing may predominate, depending on the temperature. Author

N65-21308*# General Dynamics/Electronics, Rochester, N. Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 7, 1–31 Jan. 1965
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany [1965] 14 p ref
(Contract NASw-1008)
(NASA-CR-57823) CFSTI: HC $1.00/MF $0.50

The emission of 1 wt% Nd^{3+} in yttrium aluminum garnet (YAG) in the wavelength range 1.05μ to 1.08μ was studied as a function of temperature between +100° and −196° C, giving a clearer picture of the reasons for the unusual reduction of YAG:Nd^{3+} laser threshold with lowering of temperature near room temperature. The shift of laser emission with homogeneous pulsed magnetic fields was also studied over the same temperature range by time-resolved spectroscopy. For the transition responsible for laser emission above −50° C the highest gain Zeeman component has an apparent g value of −2.51, with a weaker +2.51 component observable at the low temperature end of the range over which this transition oscillates. The highest gain component of the low temperature laser transition has a g value of +1.94. Author

N65-21331*# Field Emission Corp., McMinnville, Oreg.
INVESTIGATION OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Quarterly Progress Report No. 1, 28 Sep.–27 Dec. 1964
L. W. Swanson and L. C. Crouser 27 Jan. 1965 61 p refs
(Contract NASw-1082)
(NASA-CR-57947) CFSTI: HC $3.00/MF $0.75

Measurements of the energy exchange accompanying field emission were performed on clean tungsten and zirconium–oxygen coated tungsten surfaces. The results show the occurrence of both a heating and a cooling mechanism accompanying field emission depending on the exact value of the temperature, work function, and applied electric field. In the case of Zr/O_2 coated tungsten surfaces with a work function of 2.6 eV, emission cooling occurred for temperatures above 450° K at an electric field of 23 MV/cm; clean tungsten surfaces exhibiting a work function of 4.52 eV gave evidence of emission cooling for temperatures above 1090° K at an electric field of 48 MV/cm. A brief investigation of the variation of field emission with temperature for Zr/O_2 coated tungsten surfaces was performed over the temperature range 300° to 1100° K. An increase in the emission with temperature was observed, and attributed both to a decrease in work function with increasing temperature and predicted increase due to thermal-enhanced field emission. A coefficient of work function change with temperature of approximately 10^{-3} eV/degree was found. Author

N65-21343*# Midwest Research Inst., Kansas City, Mo.
THE EMISSION OF EXO-ELECTRONS FROM ALUMINUM DURING FATIGUE Final Report, 1 Sep. 1961–30 Sep. 1963
J. C. Grosskreutz and David K. Benson 25 Oct. 1963 36 p refs
(Contract NASr-63(02); MRI Proj. 2553-P)
(NASA-CR-57918) CFSTI: HC $2.00/MF $0.50

The details of exoelectron emission from fatiguing aluminum were observed. Autoradiographic experiments indicated that exoelectrons originate in slip bands and in freshly exposed crack surface. Exoelectrons emitted during fatigue stressing at 2×10^{-5} torr were detected directly with an electron multiplier. The intensity is very low. To investigate further the effects of environmental gases on exoelectron emission, experiments were performed in tension at 10^{-9} and 10^{-6} torr, again using electron multiplier detection. Sensitivity problems prevented the primary objectives, but an upper limit to the emission rate was established to be ~100 electrons/cm^2 sec at 10^{-6} torr. The evidence thus favors the view that exoelectrons are emitted from freshly exposed surface during deformation and that the process of oxidation is necessary for prompt emission. In view of the very low intensity of exoelectron emission during fatigue and the necessity of oxygen, it does not appear feasible at this time to apply the results to a means of monitoring fatigue damage. Author

N65-21354*# North Carolina State Coll., Raleigh. Semiconductor Device Lab.
THEORETICAL AND EXPERIMENTAL STUDIES OF RADIATION-INDUCED DAMAGE TO SEMICONDUCTOR SURFACES AND THE EFFECTS OF THIS DAMAGE ON SEMICONDUCTOR DEVICE PERFORMANCE Semiannual Progress Report No. 2, 1 Sep. 1964–28 Feb. 1965
[1965] 50 p refs
(Grant NsG-588)
(NASA-CR-57880; SDL-2-588) CFSTI: HC $2.00/MF $0.50

A study was initiated to determine the variation in the surface potential and the surface state charge distribution in the oxide passivated materials using an insulated gate field effect transistor structure. Analytical studies of device performance with the inclusion of surface parameters were initiated. Some preliminary results are included for the one-dimensional planar solar cell. Author

N65-21459*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
RADIATION EFFECTS ON SILICON Second Quarterly Progress Report, Sep. 1–Nov. 30, 1964
H. K. Lintz, D. P. Snowden, and V. A. J. van Lint 14 Dec. 1964 19 p refs
(Contract NAS7-289)
(NASA-CR-62191; GACD-5974) CFSTI: HC $1.00/MF 40.50

The primary data from electron spin resonance measurements on phosphorus-doped n-type floating-zone silicon are values of the introduction rate of the vacancy-phosphorus defect produced by room-temperature irradiation at 8, 15, and 30 MeV. In addition one, and possibly two, previously unreported centers were observed in 0.1 ohm-cm P-doped silicon irradiated at 300° K with 30 MeV electrons with fluxes between 3.7×10^{16} and 9.2×10^{16} cm^{-2}. The Fermi level in these samples is above that value for which the vacancy-phosphorus resonance is seen. Carrier lifetime measurements were made on n- and p-type silicon by the pulsed dc conductivity method. The microwave method was used to check the pulsed dc measurements for possible errors introduced by the contacts. The data-reduction computer program was modified to eliminate extensive manual plotting and fitting of decay curves. Measurements were taken rapidly at a large number of temperatures to form a continuous curve of $\tau(T)$. Measuring circuit improvements decreased the rf noise interference, allowing more accurate measurements of short decay times. E.P.V.

N65-21476*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANOMALOUS THERMOLUMINESCENT KINETICS OF IRRADIATED ALKALI HALIDES
J. A. Partridge and C. E. May 1 May 1964 6 p refs Submitted for Publication
(NASA-TM-X-51727) CFSTI: HC $1.00/MF $0.50

Certain experimental results (at least for NaCl) indicate that the anomalous kinetics are associated with the absence of OH^- ions: (1) Not all samples for which $n < 1$ were examined for OH^- content, but the ones that were examined showed essentially no OH^- absorption band. (2) Harshaw NaCl that

had been heat treated in an HCl atmosphere to neutralize the OH^- ions had no OH^- absorption band and showed $n < 1$. (3) NaCl samples, normally showing $n < 1$, showed as high as 3/2's-order kinetics as well as the OH^- absorption band, after being heated near the melting point in moist argon for 48 hr. The variability of order from source to source in this latter case indicates that the OH^- ion may not be the sole entity involved. Author

N65-21486 Illinois Univ., Urbana. Dept. of Mining, Metallurgy, and Petroleum Engineering
DISLOCATIONS IN SOLIDS Final Report
R. Thomson 20 Dec. 1964 9 p refs
(Grant AF-AFOSR-62-179)
(AFOSR-65-0061; AD-610014)

The major experimental effort centered on the electronic structure of dislocations in semiconductors. Attempts to measure the light absorption due to dislocations in these crystals, the possible effect of screw versus edge dislocations, and crystal orientation with polarized light did not show any absorption connected with microscopic states on the dislocations, but an apparent scattering of the absorption from the dislocation planes. The design and construction of an experimental apparatus for the detection of photoelectrons was completed. The theory of dislocation mobility was extended to internal frictions in semiconductors with theoretical predictions for the complete picture by a new mathematical approach employing response functions to describe the vibrating crystal. Studies in the electronic structure of point defects in the alkali halides, electrical signal generation by shock waves in metals, stacking faults, density effects of the conduction band in transition metals, and the relationship between the lattice vibration of the crystal and the imbedded dislocations were started. G.G.

N65-21523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RECOMBINATION OF CURRENT CARRIERS IN SEMICONDUCTORS
A. Czachor and J. Piekoszewski 5 Mar. 1965 23 p refs Transl. into ENGLISH from Postepy Fiz. (Poland), v. 15, no. 1, 1964 p 31–45
(FTD-TT-64-1146/1+2+3+4; AD-458849)

Electron–hole recombination, or the shift of an electron from the conduction to the valence band in the band model of a semiconductor by means of local level shift in the forbidden band, is discussed. The kinetic equations of the electron–hole recombination process are formulated. Of the three possible types of local levels—impurities, traps, and recombination centers—only the last is considered. The mechanism of recombination by recombination levels consists in the simultaneous transition of the electron from the conduction band and of the hole from the ground band into this level. Single level and multilevel recombination are developed, and fundamental expressions are given. Also, experimental methods for determining recombination parameters are summarized. Further, the expression for the change in conductivity for the case of steady-state measurement of photoconductivity, when the carriers in the semiconductor are generated by a square light pulse considerably longer than the lifetime of the carrier, is given. E.E.B.

N65-21543# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF HIGHER EDUCATIONAL INSTITUTIONS, PHYSICS (SELECTED ARTICLES)
3 Jun. 1963 42 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaveden II, Fiz. (Tomsk), no. 5, 1962 p 34–45, 150–160
(FTD-TT-63-350/1+2+4; AD-413570)

CONTENTS:

1. DIELECTRIC PROPERTIES OF INSULATING MATERIALS UNDER GAMMA-IRRADIATION 2. POLYETHYLENE B. I. Vorozhtsov, V. M. Nesterov, and N. I. Ol'shanskaya p 1–7 refs (See N65-21544 11-26)

2. INVESTIGATION OF THE ELECTRICAL FORMING OF POINT-CONTACT DIODES A. P. Vyamkin and A. A. Vilisov p 8–20 refs (See N65-21545 11-26)

3. VARIATION OF DIELECTRIC LOSSES IN CRYSTALLIZING POLYMERS UNDER THE ACTION OF IONIZING RADIATION N. L. Ol'shanskaya and B. L. Vorozhtsov p 21–30 refs (See N65-21546 11-26)

4. TEMPERATURE DEPENDENCE OF THE SATURATION MAGNETOSTRICTION OF SINGLE CRYSTALS OF FERROSILICON A. Ya. Vlasov and L. L. Gus'kova p 31–39 refs (See N65-21547 11-26)

N65-21544 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIELECTRIC PROPERTIES OF INSULATING MATERIALS UNDER GAMMA-IRRADIATION. 2. POLYETHYLENE
B. I. Vorozhtsov, V. M. Nesterov, and N. I. Ol'shanskaya *In its* J. of Higher Educ. Inst., Phys. 3 Jun. 1963 p 1–7 refs (See N65-21543 11-26)

Experimental results obtained from investigation of electrical properties of polyethylene in a zone of gamma irradiation are presented. It is shown that at the moment of irradiation the dielectric loss-angle tangent and conductivity of polyethylene increase; the increase is the greater, the lower the temperature of the material in the radiation field. In the case of irradiation at $T = 70°C$ the dielectric strength decreases with an increase in absorbed dose. The conductivity of polyethylene in the dose range from 0 to 10^6 rad is independent of the absorbed dose. The dielectric loss-angle tangent was observed to be independent of dose in the range 0 to $3 \cdot 10^5$ rad. Author

N65-21545 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ELECTRICAL FORMING OF POINT-CONTACT DIODES
A. P. Vyamkin and A. A. Vilisov *In its* J. of Higher Educ. Inst., Phys. 3 Jun. 1963 p 8–20 refs (See N65-21543 11-26)

The process of forming point diodes on a base of gallium arsenide as well as germanium and silicon arsenide of various resistivities and types of conductance was studied by the method of measurement of thermal emf. Electron-hole junctions were produced from the formation of gallium p-arsenide. Author

N65-21546 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIATION OF DIELECTRIC LOSSES IN CRYSTALLIZING POLYMERS UNDER THE ACTION OF IONIZING RADIATION
N. I. Ol'shanskaya and B. I. Vorozhtsov *In its* J. of Higher Educ. Inst., Phys. 3 Jun. 1963 p 21–30 refs (See N65-21543 11-26)

The dielectric properties of a number of crystallizing polymers were investigated under X-ray, ultraviolet, and gamma irradiation. It is shown that the dielectric loss-angle tangent

varies the more significantly during irradiation, the greater the crystallinity of the sample. The observed effects have a reversible character. Author

N65-21547 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEMPERATURE DEPENDENCE OF THE SATURATION MAGNETOSTRICTION OF SINGLE CRYSTALS OF FERROSILICON
A. Ya. Vlasov and I. L. Gus'kova *In its* J. of Higher Educ. Inst., Phys. 3 Jun. 1963 p 31–39 refs (See N65-21543 11-26)

Constants of magnetostriction of a single crystal of ferrosilicon (3.5% silicon) for directions [100], [110], and [111] in the plane (110) and with their variation with temperature over the range from −196° to 800° C were determined. The domain structure of the test samples was studied at the same time. Author

N65-21562# IIT Research Inst., Chicago, Ill.
MECHANICAL RELAXATION OF TWO TYPES OF DEFECT IN MAGNESIUM OXIDE CRYSTALS Final Report, Feb. 1, 1964–Jan. 31, 1965
P. D. Southgate and K. S. Mendelson [1965] 57 p refs
(Grant DA-ARO-D-31-124)
(IITRI-A6075; AROD-4518-1; AD-612900)

Two point defects in magnesium oxide single crystals which give rise to internal friction peaks at 200° C and at 850° C are studied. The first, which has a reorientation activation energy 0.64 eV, is now shown to have [100] symmetry. The annealing behavior was studied in some detail, and this, together with the high preexponential factor in the relaxation time, is consistent with the defect being a trapped charge carrier. A theory is being developed in which the relaxation rate of the Jahn–Teller distortion due to an electron held in a Coulomb potential is calculated. Measurements were made on the 850° C internal friction peak, which is believed due to vacancy: impurity chromium pairs, for specimens in [100] and [111], of commercial purity, and also specially chromium doped. The peak is composed of several relaxational modes, and the temperature of these does not shift very much with orientation. The behavior deviates strongly from that predicted by a model of closely bound vacancies, and an alternative model is being developed in which the vacancies are more remotely bound so that the relaxation shows a weaker orientation dependence. Author

N65-21607 Mount Wilson Observatory, Pasadena, Calif.
ABUNDANCES IN NORMAL STARS AND AM STARS USING SEMIEMPIRICAL MODEL ATMOSPHERES
Peter S. Conti (Palomar Obs.) *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 312–316 (See N65-21575 11-30)

Model atmosphers were used to study the abundance of elements in stars of the Hyades. Line strengths represented by equivalent widths are used, as well as relative abundances (relative to one or more standard stars measured and treated identically), where several kinds of approximations can be made in the models. Abundances using the observed equivalent widths are discussed. Preliminary results are reported. A more detailed study of Am stars over a more narrow temperature range was made previously. Author

N65-21620# AVCO-Everett Research Lab., Everett, Mass.
STABLE SUPERCONDUCTING COILS
Z. J. J. Stekly and J. L. Zar Mar. 1965 20 p refs
(RR-210)

This paper describes the principles of stabilizing a superconductor and the principles of a stable superconducting coil operation. A coil of this type not only operates on the short sample characteristic, but also does not exhibit the uncontrolled transition to the normal state characteristic of conventional superconducting coils. Two main problems have plagued the field of superconducting coils in the past, namely the fact that current carrying capacity in a coil is in general not predictable and is considerably reduced from the current carrying capacity on short samples, and the transition to the normal state is uncontrollable when the maximum current is reached, resulting in loss of the magnetic field. In contrast, the stabilized coil has a gradual rise of resistance as the critical current is exceeded. As the current is reduced again, the coil becomes completely superconducting at the same current value that resistance first appeared. The coil performance is reviewed with respect to the measured short sample characteristics. The achievement of this performance now removes any limitations on size or magnetic field of superconducting coils except those imposed by stress and the basic superconductor itself. Author

N65-21681 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
GENERATION OF OPTICAL HARMONICS
Howard J. Okoomian *In its* Electro Optics 1964 p 28–31 refs (See N65-21675 11-14)

Harmonic generation provides a means of determining the properties of certain crystalline materials by direct interaction between matter and the intense electric and magnetic fields available from laser sources of electromagnetic radiation. For hardware applications, high-power coherent radiation at frequencies heretofore unavailable for a new class of coherent optical instruments and systems can be produced. Rangefinders, tracking equipment, communications systems, and underwater illumination are listed. As an example of its special utility in a particular application, a completely self-contained submersible transmitter using second harmonic radiation of 5300 Å with a Q-switched neodymium–glass laser for the fundamental radiation of 10 600 Å was constructed and tested under water. A particular advantage to this application is that transmission in sea water is maximal for green radiation. E.E.B.

N65-21700# Ecole Normale Superieure, Paris (France). Laboratoire de Physique
RADIATION DAMAGE IN SEMICONDUCTORS Annual Summary Report No. 3, Jul. 1963–Jul. 1964
P. Baruch 10 Oct. 1964 29 p refs
(Contract AF 61(052)-543)
(AFCRL-65-31; AD-612090)

CONTENTS:

1. DRIFT MOBILITY OF RADIATION INDUCED DEFECTS IN SILICON E. Davoust-Saltiel and P. Baruch 11 p refs (See N65-21701 11-26)
2. RADIATION ENHANCED DIFFUSION IN SILICON J. C. Pfister 9 p refs (See N65-21702 11-26)
3. LOW TEMPERATURE IRRADIATION OF SEMICONDUCTORS J. Zizine et al 4 p (See N65-21703 11-26)

N65-21701 Ecole Normale Superieure, Paris (France). Laboratoire de Physique
DRIFT MOBILITY OF RADIATION INDUCED DEFECTS IN SILICON

E. Davoust-Saltiel and P. Baruch *In its* Radiation Damage in Semicond. 10 Oct. 1964 11 p refs (See N65-21700 11-26)

The drift of radiation-induced defects in silicon, under the electric field of a reverse biased p-n junction, was observed. The defects were created by 1.2 MeV electrons whose spatial distribution and velocity were deduced from the capacitance vs bias relation. The drift of charged defects with temperature was observed. Between 55° and 85°C, the mobile center is negatively charged, with a mobility of 1.8×10^{-14} cm^2/V-sec at 70°C. The activation energy is 0.95 eV; the center can be identified with the phosphorus-vacancy complex. Above 120°C, another center negatively charged is mobile, and corresponds to the vacancy–oxygen complex. Between 0° and 17°C, two different defects of opposite charges appear to move. They have not been identified. Author

N65-21702 Ecole Normale Superieure, Paris (France). Laboratoire de Physique

RADIATION ENHANCED DIFFUSION IN SILICON

J. C. Pfister *In its* Radiation Damage in Semicond. 10 Oct. 1964 9 p refs (See N65-21700 11-26)

The impurity diffusion in silicon during charged particle irradiation can be accounted for on the basis of the following model: Vacancies created by irradiation enhance impurity diffusion. Their migration is slowed down by the presence of trapping centers. Vacancy annealing is a first-order reaction at high temperatures (1000°C or above); the vacancy sinks are the dislocations and some other unidentified centers. At low temperatures (800° to 900°C), vacancy precipitation creates new defect sinks in the form of vacancy clusters, and the diffusion length of vacancies is reduced, leading to a decrease in impurity diffusion. Author

N65-21703 Ecole Normale Superieure, Paris (France). Laboratoire de Physique

LOW TEMPERATURE IRRADIATION OF SEMICONDUCTORS

J. Zizine et al *In its* Radiation Damage in Semicond. 10 Oct. 1964 4 p (See N65-21700 11-26)

A cryostat was tested for vacuum and cryogenic capacities, and is presently being tested for temperature measurements. A special spectrophotometer to allow measurements in situ is being assembled. For pulse irradiation experiments, a beam pulser added to the Van de Graaff features three pulse durations (1/2, 10, and 20 μseconds). The pulse peak intensity, presently 2 mA, can be raised to 10 mA. Work is also being done on the detection of the Hall effect voltage. L.S.

N65-21760*# Texas Univ., Austin. Electronic Materials Research Lab.

MICROELECTRONICS RESEARCH ON SILICON-SILICON OXIDE STRUCTURES AND INTERFACES Third Quarterly Report, 1 Dec. 1964–28 Feb. 1965

28 Feb. 1965 80 p refs

(Contract NAS8-11235)

(NASA-CR-62259) CFSTI: HC $3.00/MF $0.75

Theoretical capacitance vs. voltage, approximate formulas for calculating minimum value capacitance ratio, and dissipation phenomena are considered under theory of M-O-S structure. Silicon sample preparation and experimental results are reported under experimentation and analysis. Also, breakdown studies using the curve tracer and an electrometer are discussed. Transmission electron microscopy and the replication of silicon surfaces are considered. Further, a pulsed laser system for the study of semiconductors, ellipsometry, infrared internal reflection, and fluorescence of silicon oxide are the analytical techniques explored. Quality control measures included possible ways for using the results in improved device manufacture. E.E.B.

N65-21762*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

RADIATION EFFECTS ON SILICON Third Quarterly Progress Report, Dec. 1, 1964–Feb. 28, 1965

D. K. Nichols, D. P. Snowden, and V. A. J. van Lint 15 Mar. 1965 17 p refs

(Contract NAS7-289)

(NASA-CR-62241; GACD-6249) CFSTI: HC $1.00/MF $0.50

Measurements of the introduction rate of the silicon G-8 center, the vacancy-phosphor defect, were completed, and their energy dependence was plotted. The relative accuracy of the results is estimated to be ±15%. The divacancy in floating-zone p-type silicon, irradiated at 300°K and doped with 1.2×10^{17} cm^{-3} boron, showed large and easily measured resonance signals. The introduction rates for those divacancies formed directly by the incident electrons, and those subsequently formed by the combination of single vacancies are presented in combined form. Lifetime measurements on n- and p-type silicon were performed by the dc conductivity and the microwave conductivity techniques, and an analysis was performed on some p-type dc experiments. The results of 10 ohm-cm p-type silicon irradiated with 30-meV electrons show that the high-injection level lifetimes are independent of temperature, but that a strong temperature dependence is observed in low-injection lifetimes. From experimental data and theoretical calculations it was concluded that the recombination center in p-type irradiated silicons is a net donor which lies below the center of the gap and has an activation energy of ~0.35 eV. G.G.

N65-21767*# Radio Corp. of America, Princeton, N. J.

INTERACTION OF ELECTRONIC CURRENT WITH HYPERSONIC WAVES IN SOLIDS Quarterly Progress Report No. 3, Apr. 1–Jun. 31, 1964

R. W. Smith and R. F. Mayo 10 Jul. 1964 23 p refs

(Contract NAS8-11120)

(NASA-CR-62254) CFSTI: HC $1.00/MF $0.50

The interaction of electronic current with hypersonic waves in solids was studied for a better understanding of the acoustoelectric effect in CdS crystals operated in a current saturation region. Theoretically, bunched electrons moving through the CdS crystal should give rise to a rf component of current in the 1 kMc frequency band, but a low signal has always been detected. However, this signal may not be due to spurious effects as previously believed. The temporal form of the rf signal is now better understood in terms of the rise time and duration of the exciting voltage pulse. The diodes were not as passive as had been assumed. The rf spectral distribution was completely different than had been expected. Impedance measurements were attempted, but no change in the crystal impedance or in coherent or incoherent X-band power could be detected in the waveguide. Practically all CdS crystals oscillated during some stage of operation and were associated with a high power level. Geometry may be an important factor in the large amplitude oscillations. A one-dimensional approximation to the rf impedance of a CdS post with a dc applied electric field is appended. R.N.A.

N65-21800# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF THE ACADEMY OF SCIENCES OF THE USSR: PHYSICS SERIES

5 Mar. 1965 25 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR., Ser. Fiz. (Moscow), v. 28, no. 3, 1964 p 533–536, 540–544, 580–583
(FTD-TT-65-131/1+2; AD-612418)

CONTENTS:

1. SATURATION MAGNETIZATION OF FERROMAGNETS AT HELIUM TEMPERATURES N. V. Zavaritskiy and V. A. Tsarev p 1–6 refs (See N65-21801 11-26)

2. EFFECT OF MAGNETIC ORDER ON ELECTRIC AND GALVANOMAGNETIC PROPERTIES OF RARE EARTH METALS N. V. Volkenshteyn, G. V. Fedorov, and V. Ye. Startsev p 7–13 refs (See N65-21802 11-26)

3. EFFECT OF DEFORMATION ON THE ANISOTROPY OF COERCIVE FORCE OF IRON SILICIDE MONOCRYSTALS Ye. G. Krivonosova and B. G. Livshits p 14–21 refs (See N65-21803 11-26)

N65-21801 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SATURATION MAGNETIZATION OF FERROMAGNETS AT HELIUM TEMPERATURES

N. V. Zavaritskiy and V. A. Tsarev *In its* News of the Acad. of Sci. of the USSR, Phys. Ser. 5 Mar. 1965 p 1–6 refs (See N65-21800 11-26)

Instantaneous rate of change of magnetic moment, dM/dt, in nickel and iron, was studied experimentally with respect to its dependence on temperature and magnetic field. Determination of magnetic moment was based on the Bloch law for spontaneous magnetic moment, $M_s = M_0 (1 - CT^{3/2})$, in which M_0 is an initial value, t is time, and C is a constant to be estimated experimentally. From measurement of the susceptibility of polycrystalline nickel, a functional relationship, $M = f(M_s, M_0, t)$, was derived for study of dM/dt. Graphs are presented which show change in dM/dt with increasing level of magnetic field for polycrystalline nickel and iron and for nickel monocrystal; temperatures in the range 2° to 5° K were evaluated separately. In each case the value of dM/dt rose sharply to a certain point, and then began a gradual drop apparently due to change in dM_s/dt in the field. A steadily increasing dependence of $dM/(dt.M_0)$ on temperature in the range 0° to 5° K was observed for polycrystalline iron and for nickel monocrystal. J.M.D.

N65-21802 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF MAGNETIC ORDER ON ELECTRIC AND GALVANOMAGNETIC PROPERTIES OF RARE EARTH METALS

N. V. Volkenshteyn, G. V. Fedorov, and V. Ye. Startsev *In its* News of the Acad. of Sci. of the USSR, Phys. Ser. 5 Mar. 1965 p 7–13 refs (See N65-21800 11-26)

Electrical resistance and Hall effect for a large group of rare earth metals were measured simultaneously. Temperature dependence of specific resistance was observed in the range 0° to 300° K, and from these results the metals can be described in three classes: (1) lanthanum, cerium, praseodymium, neodymium, and ytterbium, in which there is an absence of linear temperature dependence, due apparently to presence of spin disorderliness; (2) samarium, gadolinium, terbium, dysprosium, helmium, erbium, and thulium in which the curve is linear over the entire range with an abrupt change in slope at the point of transition from paramagnetic into antiferromagnetic state; and (3) europium, in which there is no evidence of linearity and also a sharp change at the transition point. For all investigated metals a definite linear dependence was observed when the Hall emf (per unit of current density) was measured at various levels of magnetic induction from 0 to 25 B.kGs in the paramagnetic state, and was observed in the antiferromagnetic zone up to the critical fields of antiferromagnetism destruction. J.M.D.

N65-21803 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF DEFORMATION ON THE ANISOTROPY OF COERCIVE FORCE OF IRON SILICIDE MONOCRYSTALS

Ye. G. Krivonosova and B. G. Livshits *In its* News of the Acad. of Sci. of the USSR, Phys. Ser. 5 Mar. 1965 p 14–21 refs (See N65-21800 11-26)

Anisotropy of coercive force was studied in iron silicide monocrystals (3% Si) which were stretched out on a tensile testing machine and then etched out into strips in various crystallographic directions. The anisotropy relationship $H_{c(100)} < H_{c(110)} < H_{c(111)}$ was supported by the experimental data. It was found that plastic elongation along the direction [001] changes the nature and raises the value of coercive force anisotropy of certain deformed crystals. Annealing of deformed samples in magnetic protection at 400° C caused a readjustment of magnetic structure. Annealing at 700° C led to a reduction in coercive force in all directions. At low temperatures, annealing resulted in a sharp reduction in the value of coercive force anisotropy. J.M.D.

N65-21813# Oak Ridge National Lab., Tenn. Health Physics Div.

A NEW TECHNIQUE FOR MEASURING RANGE OF LOW ENERGY CHARGED PARTICLES IN CONDUCTING SOLIDS

A. K. Roecklein, M. Y. Nakai, E. T. Arakawa, J. L. Stanford, and R. D. Brikhoff (M.S. Thesis—Vanderbilt Univ.) Mar. 1965 58 p refs
(Contract W-7405-ENG-26)
(ORNL-3702) CFSTI: $3.00

A method is described for measuring ranges of charged particles in conducting solids, and experimental data are presented for proton ranges in aluminum at energies less than 10 keV. A thickness of aluminum greater than the maximum range of protons at this energy is evaporated onto a glass substrate in a system evacuated to 1.0×10^{-5} mm Hg. This layer is covered by thin ($\leq$ 75 Å) layer of silicon monoxide. The thickness of the SiO layer was determined both by a neutron-activation-beta-counting procedure and by use of a quartz-oscillator, film-thickness monitor during evaporation. A second aluminum layer was then evaporated onto the SiO layer and its thickness measured by optical interferometry. The aluminum layers were separated by an electrical resistance across the SiO layer of the order of 1 megohm; each was provided with current leads to a galvanometer. Author

N65-21921# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research

NOTE ON CALCULATIONS OF DISPERSION CURVES IN ZINC

A. Holas Nov. 1964 10 p refs Presented at the IAEA Symp. on the Inelastic Scattering of Neutrons, Bombay, 15–19 Dec. 1964
(Rept.-571/II)

An attempt was made to describe the irregular shape of the experimental phonon dispersion curve in the [0110] direction for zinc, using the harmonic Born–von Karman approximation. The general dispersion relations for hexagonal close-packed structure given as functions of atomic force constants of an unlimited number of neighbors were employed. Using

them, the least squared fitting of theoretical curves to experimental points has been made, taking into account the interactions with neighbors situated up to the distance 3 times lattice constant a. In spite of that, the calculated curves do not follow satisfactorily the experimental points. Thus it seems the observed irregularity is due to anharmonicity or electron–phonon interaction effects. Author

N65-21955# Pennsylvania State Univ., University Park. College of Engineering
CRYSTAL IMPERFECTIONS BY ELECTRON TRANSMISSION MICROSCOPY
M. C. Inman [1964] 53 p refs

The fundamentals of electron transmission microscopy are presented. A survey is made of the crystal imperfections which can be imaged in electron transmission. The following are demonstrated: methods of preparation of thin-film specimens; the observation and interpretation of selected area diffraction patterns of thin metal crystals, and correlation with the direct image; diffraction contrast effects, such as wedge fringes and bend contours, etch pits, dislocations and stacking faults, dislocation slip traces; new developments, such as studies of relative grain boundary and twin boundary energies, stacking fault energies, solute segregation, and brittle fracture problems, by quantitative analysis of transmission electron micrographs; application of color photography methods in electron microscopy; and interpretation of the structures associated with the mechanical properties of solids. Author

N65-22021# Leicester Univ. (England).
INVESTIGATION OF CHARGE TRANSPORT IN CdS AND OTHER II-VI COMPOUNDS Final Technical Report, 1 Dec. 1963–31 Dec. 1964
Walter Eric Spear Dec. 1964 49 p refs
(Contract DA-91-591-EUC-3186)
(FTR-5; AD-457863)

Experimental work is described on the interaction of generated charge carriers with the piezoelectric lattice modes in thin, highly resistive specimens of CdS and ZnS. By the application of fast pulse techniques the drift velocity v can be obtained directly, and it is possible to study acoustoelectric interaction during a single carrier transit. Pronounced discontinuities occur in v vs applied field curves at a critical velocity, which is in good agreement with the known velocity of sound in the particular crystallographic direction. A clear distinction between longitudinal and transverse wave interaction with both electrons and holes is obtained in CdS. Transient current pulse height experiments lead to results consistent with the drift velocity experiments. The effect of shallow trapping was investigated by measurements at lower temperatures. The result of all these experiments is the strong localized acoustoelectric interaction which builds up within a fraction of a transit time. In view of the low carrier density in the drifting layer this cannot be understood in terms of a linear amplification theory. Various models are discussed, and it is tentatively suggested that a piezoelectric shockwave of sufficient amplitude might be produced by the fast excitation pulse used for carrier generation. Author

N65-22047# Oklahoma State Univ. Research Foundation, Stillwater. Solid State Lab.
PHOTOELECTRONIC ANALYSIS OF IMPERFECTIONS IN GROWN STANNIC OXIDE CRYSTALS
Jack E. Houston and E. E. Kohnke Feb. 1965 148 p refs
(Contract Nonr-2595(01))
(TR-4; AD-611392)

A study of the imperfection properties of grown stannic oxide single crystals was made using photoelectronic techniques. The primary purpose was to propose an energy level scheme for defects in these samples based on the results of spectral response, thermally stimulated current, thermal quenching, dark conductivity as a function of temperature, and photothermoelectric voltage measurements. Thermally stimulated current results indicate the existence of three trapping levels with average activation energies of 0.21, 0.52 and 0.60 ev. Extrinsic thermal quenching results have established that these levels are all trapping states for electrons, implying that the two shallow ones are completely compensated while the deeper one is only partially compensated. Intrinsic thermal quenching measurements indicate the existence of a compensated acceptor level lying 0.33 ev above the valence band and acting under certain conditions as a sensitizing center. Also found are more-or-less discrete levels having optical activation energies of approximately 1.0, 1.3 and 1.8 ev. TAB

N65-22049# Naval Ordnance Lab., White Oak, Md.
THE APPLICATION OF MAGNETORESISTANCE TO HIGH-FREQUENCY MAGNETOMETERS
R. S. Hebbert, M. Stern, and H. R. Irons Feb. 1965 15 p
(NOLTR-64-145; DASA-1560; AD-611091)

This report describes the magnetoresistance properties of evaporated permalloy films and their application to magnetometers with high frequency response. Response times of the order of nanoseconds are possible while sensitivities may be varied greatly by choice of composition, magnetic bias or eddy-current field shunts. The resistance variation with direction of magnetization is also observed with ac currents as high as X-band. It is concluded therefore that an ac magnetoresistive bridge (bridge frequency of the order of 1 gc) would provide a suitable magnetometer in the presence of strong electric fields or other disturbances. Author

N65-22062# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF DISRUPTIVE DISCHARGE OF DIELECTRICS
I. G. Nekrashevich and I. A. Bakuto 2 Apr. 1963 10 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 6, no. 1, 1962 p 26–30
(FTD-TT-63-5/1+2+4; AD-415656)

The disruptive discharge of any dielectric can be described by proceeding from the general energy relationship expressed by the following equation:

$$\alpha \frac{\delta T}{\delta t} = \operatorname{div}(k \operatorname{grad} T) + w_K = \frac{\delta \Phi_0}{\delta t} w_0$$

where w_k represents work accomplished in a given system by external forces in a given volume in a unit of time. The case of disruptive discharge of a dielectric by the positive and negative carriers of the charge resulting from the particles attaining the critical energy value necessary to pass from the initial state into that of ionization will change the magnitude w_K by the power density of the electric current to $w_K = jE = qnvE$, which characterizes the intensity of the conversion of the electric field energy in the volumetric unit under examination. The subsequent analysis of the equations of thermal breakdown showed that the disruptive strength is smallest for the gaseous phase and greatest for the solid phase of a dielectric material. G.G.

N65-22108# Stanford Research Inst., Menlo Park, Calif. Poulter Research Labs.
SHOCK COMPRESSION OF CRUSTAL ROCKS: DATA FOR QUARTZ, CALCITE AND PLAGIOCLASE ROCKS

T. J. Ahrens and V. G. Gregson, Jr. 1 Jul. 1964 84 p refs (TR-004-64)

Hugoniot data in the 4- to 250-kb stress range are obtained for quartzite and novaculite, sandstones of varying porosity, single-crystal calcite, marble, porous and nonporous limestone, several plagioclases of varying composition, and a basalt. Conventional plane-wave, in-contact explosive assemblies are used; the shock state is computed from measured shock velocities; particle velocities are inferred from either specimen or driver plate free-surface motion. Impedance-match solutions are obtained for porous rock. High values of the Hugoniot elastic limit are observed in nonporous rocks. Porous rocks show reduced values, approximately 5 kb in sandstone and limestone. Anomalously low volumes achieved by sandstone shocked to above approximately 40 kb, and high calculated shock temperatures suggest partial conversion to coesite or stishovite. High-pressure states observed in basalt and plagioclase agree with previously reported states for gabbro above 300 kb when both data are plotted in terms of relative volume. The previously observed slope-change of the gabbro Hugoniot is believed to result from an elastic wave of perhaps 50-kb amplitude which is overdriven at 300 kb and not from a polymorphic transition. Author

N65-22184*# Chicago Univ., Ill. Labs. for Applied Sciences
STABILITY OF FLUORESCENCE OF SODIUM SALICYLATE
Rinda Allison, Jay Burns, and A. J. Tuzzolino [1964] 3 p refs (Grant NsG-276)
(NASA-CR-56503) CFSTI: HC $1.00/MF $0.50

An investigation of the stability of sodium salicylate as a vacuum ultraviolet radiation detector is reported. In contrast to results of previous investigations in respect to a variation with time of fluorescent yield for thin layers of sodium salicylate, the yield of this material was found to be stable over long periods of time provided caution was used to prevent its contamination by impurities as vacuum pump oils which are fluorescent. The effects of uv radiation on yield of several samples were determined and the relative yields did not vary by more than 3%. Also investigated was the validity of observations indicating that a weak maximum existed in the yield curve for sodium salicylate superimposed upon a gradual increase in yield at longer wavelengths and that the yield at 1610 Å was 14% higher than the yield at 1215 Å for fresh samples less than 1 hour old. Results show that yields at these two wavelengths were the same within 1% to 2%, the variation in previous yields being attributed to pump oil contamination. Speculation is made concerning the influence of wavelength dependence of the fluorescent yields of common diffusion pump oils. S.C.W.

N65-22191*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORRELATION OF ULTRAVIOLET EXCITED LUMINESCENCE AND INTERBAND TRANSITIONS IN HEXAGONAL ZINC SULFIDE
William C. Walker [1964] 16 p refs Submitted for Publication
(NASA-TM-X-51720) CFSTI: HC $1.00/MF $0.50

Measurements of the ultraviolet luminescent excitation spectrum, reflection spectrum, and photoemission of single crystal hexagonal zinc sulfide for the spectral region 3 to 11 eV are presented. A tentative assignment of reflection peaks to specific interband transitions is made and used to discuss the structure observed in the luminescent excitation spectrum on the basis of assumptions concerning the luminescent mechanism. Evidence is presented to support the contention that the structure in the excitation spectrum is mainly controlled by the dependence of the electron transport and trapping efficiency on the final states of the various interband transitions. Author

N65-22204*# Stanford Univ., Calif. Dept. of Physics
PHONON INDUCED RELAXATION IN EXCITED OPTICAL STATES OF TRIVALENT PRASEODYMIUM IN LaF_3
W. M. Yen, W. C. Scott (NSF), and A. L. Schawlow [1964] 59 p refs Submitted for Publication
(Grant NsG-331)
(NASA-CR-56902) CFSTI: HC $3.00/MF $0.50

Phonon–ion interactions have been shown to explain the temperature dependence of widths and positions of the R lines of some 3d ions in crystals. These interactions, which rise to phonon relaxation processes, are investigated as the mechanisms responsible for the widths and positions of sharp optical transitions in (4f) ions, in particular $LaF_3:Pr^{3+}$. The widths of transitions originating or terminating in the metastable $^3P_0$ state and involving the $^3H_4$, $^3H_6$, $^3F_2$, and $^3F_4$ states of Pr^{3+} in LaF_3 were found to be both qualitatively and quantitatively explicable in terms of lifetime broadening of the interacting states via nonradiative processes. Temperature dependent shifts measured for these groups of transitions are in qualitative agreement with theoretical predictions. Additional features of the $LaF_3:Pr^{3+}$ spectrum, including several unreported weak transitions and vibrational sidebands, are also reported. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-21212# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF FRACTIONAL AND HYDROCARBON COMPOSITION OF FUELS ON THERMAL STABILITY
Ye. M. Bushuyeva and I. Ye. Bespolov 16 Mar. 1965 13 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 8, 1963 p 49–54
(FTD-TT-64-938/1; AD-612781)

The thermal stability of 50° fractions of gas oil of catalytic cracking, Romashkin crude oil, and the hydraulically purified green oil of pyrolysis was investigated by fractional oxidation from 200° to 350° C. It was shown that the total amount of oxidation products increases with the rise in temperature of the boiling fractions. The petroleum fractions which boil away within identical temperature limits follow this sequence: hydraulically purified green oil of pyrolisis, gas oil of catalytic cracking, and Romashkin petroleum with maximum precipitation forming at 200° C. An increase of aromatic hydrocarbons in the fuel increases the content of oxidation products up to a definite concentration after which a diminution of the overall amount of sediment takes place due to the different solubilities of the highly oxidized compounds in the aromatic product. Fuel deprived of aromatic hydrocarbons is highly stable. G.G.

N65-21894# Stanford Research Inst., Menlo Park, Calif. Industrial Research Div.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Quarterly Technical Summary Report No. 1, Sep. 16–Dec. 15, 1964
Nicholas W. Tschoegl, James R. Smith, and Thor L. Smith [1964] 23 p ref
(Contract NOw-65-0061-d; ARPA Order 22)
(Rept.-13; AD-461073)

Studies of the dynamic shear modulus and bulk compressibility are discussed. The storage shear modulus for a polyurethane propellant was found to increase linearly with lateral compression up to a compressive strain of 10% to 15%. In contrast, the storage modulus of an unfilled styrene–butadiene rubber decreased linearly with the lateral compression. The modulus also depended on specimen geometry, increasing linearly with the shape factor, i.e., the ratio of the (uncompressed) specimen thickness to the cross-sectional area. Within experimental error, the loss modulus did not depend on specimen geometry. Some information was obtained on the heat buildup in propellant specimens during oscillatory testing. A qualitative discussion is given of work done to calibrate the dynamic and static bulk compressibility apparatus. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-21222 Library of Congress, Washington, D. C. Aerospace Technology Div.

SPACE APPLICATIONS OF RAMJET PROPULSION SYSTEMS

A. Surak *In its* Foreign Sci. Bull., Vol. 1, No. 3 Mar. 1965 p 23–24 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

According to Stechkin, air-breathing ramjet engines can now be used as rocket boosters within the earth's atmosphere at velocities up to Mach number M = 7 to 10. It can be expected that systems with external burning of fuel will be developed in the future, which will extend the use of ramjets to any high flight velocities. Author

N65-21268# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.

HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 10

15 Apr. 1965 36 p

(Contract DA-44-177-AMC-182(T))

(WAD-R-419-10)

Design work continued toward the finalization of the stator and rotor blades, the rotor blade–disc assembly, and the turbine shroud assembly, and heat transfer analyses were performed to determine the coolant requirements. Design effort was also directed toward establishing a development program for a sound rotor blade–disc welded joint. Specifications for a power absorber system, and preliminary requirements for sensing high temperature in advanced gas turbines are presented. G.G.

N65-21274# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center

SENSITIVITY OF PROPELLANT SYSTEMS Quarterly Report, Oct. 1–Dec. 31, 1964

F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, J. Ribovich et al 2 Mar. 1965 30 p refs

(BuWeps Order 19-65-8023-Weps)

(QR-1; AD-459475)

Techniques for the quantitative study of reaction pressures and rates of propagation were applied to neat and desensitized explosive systems, to determine the effect of scale charge size on the thresholds between high-velocity detonation (HVD), low-velocity detonations (LVD) and noninitiations (NI). A factorial experiment to determine the combined effect of oxygen balance, viscosity, and temperature on the sensitivity of a liquid explosive was made. To substantiate a proposed mechanism for propagation of LVD's, wall wave positions were localized with respect to the chemical reaction zone. A normalized Hugoniot relationship for several liquids was calculated and an approximate Hugoniot for nitroglycerin–ethylene glycol dinitrate (NG-EGDn) was determined based on an experimentally determined sonic velocity and density. L.S.

N65-21452# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

RESEARCH IN THE FIELD OF CHEMICAL PROPULSION

Marcel Barrére Dec. 1964 81 p Transl. into ENGLISH of a Report on the Conf. of Centre National d'Etude Spatiales, Paris, 4–6 May 1964

(CPIA-67; AD-454796)

Principal problems relating to the chemical propulsion technique are presented. Two types of liquid propellant rockets were distinguished, depending on whether or not they can be stored. The most modern storable propellants use nitrogen tetroxide (N_2O_4), hydrogen peroxide (H_2O_2), and chlorine trifluoride (ClF_3) as the oxidizer, and hydrazine-base as the fuel. The specific impulses obtained under standard conditions are of the order of 290 second and can be improved by adding a metal such as boron, aluminum, or lithium. Combustion, ignition, and combustion instability are discussed for liquid and solid propellants. Practical realization is difficult because it is necessary to develop with optimum concentration stable suspensions of metal in the fuel (gel). When starting with liquid hydrogen, difficulties were encountered; it was necessary to go beyond rockets containing solid or liquid propellants and to consider more flexible solutions such as those involving solid and liquid components in the same propellant. It was shown that from an energy standpoint hybrid systems lead to the highest specific impulse. It is the only system which allows an appreciable increase in performance; the optimum is obtained with a three-component propellant. R.W.H.

N65-21470*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ELECTROSTATIC THRUSTORS

Harold R. Kaufman 8 Apr. 1964 14 p Submitted for Publication

(NASA-TM-X-51747) CFSTI: HC $1.00/MF $0.50

It can be said that a thrustor is an easier device to build than a power source. The only natural limit that was found for electrostatic thrustor performance was charge–exchange impingement. For the nuclear turboelectric systems that appear nearest realization, there are the limits of nuclear radiation from the reactor, Carnot cycle efficiency for the conversion of heat to electricity, the Stefan–Boltzmann radiation law for rejecting heat from the radiators, and the impingement of meteorites on these radiators. The many studies of such power sources have shown that these natural limits can best be dealt with (and still meet the requirements for electric propulsion) by making very large power supplies. While the analyses indicate little doubt that satisfactory power sources can be built, the sizes needed make the development process a slow one.

Author

N65-21482*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRIC PROPULSION
William R. Mickelsen [1964] 16 p refs Submitted for Publication
(NASA-TM-X-51752) CFSTI: HC $1.00/MF $0.50

Present performances and operating characteristics of most thrustors now being investigated for possible propulsion applications are compared. Operating principles, efficiency considerations, operating limitations, and development problems are discussed for specific types of electromagnetic, electrothermal, and electrostatic thrustors. Concepts and devices requiring further research are emphasized, and a brief bibliography is included. E.P.V.

N65-21628*# National Aeronautics and Space Administration, Washington, D. C.
ASSOCIATION OF AN ELECTRICAL NETWORK WITH DIGITAL COMPUTERS FOR DETERMINATION OF ELECTRON TRAJECTORIES. APPLICATION TO IONIC PROPULSION
Christian Lerin Nov. 1964 182 p refs Transl. into ENGLISH of "Association du Reseau Electrique et des Calculatrices Arithmetiques pour la Determination des Trajectoires Electroniques. Application a la Propulsion Ionique" Office Natl. D'Etudes et de Rech. Aerospatiales, Chatillon-sous-Bagneux, France
(NASA-TT-F-9151; ONERA-TN-73) CFSTI: HC $5.00/MF $1.25

In an ionic propulsor, determination of the trajectories of the particles from the emitting electrode is required to define the efficiency and, if necessary, to modify the relative configuration of the electrodes. For solving this problem, an iterative calculation method, combining analog and digital computers, is presented. The electric potential inside the drive is simulated by the voltage of a resistance network whose elements and boundary conditions are adjusted, while the trajectories and the space charges are defined from the voltage distribution by means of a digital computer. The principle of the method is checked on an analytically computable example, after which a special design of an axially symmetrical drive is described. Author

N65-21706# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
PARTICLE GROWTH IN THE IONIC NUCLEATION CONDENSATION COLLOIDAL ION SOURCE
A. Lucile Cox Mar. 1965 74 p refs
(R-139)

This analytical treatment of the ionic nucleation condensation colloidal ion source examines the processes involved in the formation and growth of ionic nuclei under controlled conditions. The analysis of the condensation nuclei considers the formation of neutral nuclei, which must be prevented, and the formation of the required ionic nuclei. Several theoretical concepts of nucleation are examined. Since the growth of the nuclei to colloids of a size suitable for use in electrostatic propulsion engines involves a considerable release of heat, the growth process is analyzed on the basis of three different models for the dissipation of the heat of condensation. The conditions and resultant properties are calculated for a mixed propellant flow of cadmium and hydrogen on the basis of each of these three models. Author

N65-22000# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency
DESIGN AUTOMATION
Feb. 1965 43 p Proc. of the 11th Meeting of the ICRPG Working Group, Silver Spring, Md., 4–5 Feb. 1965
(CPIA-Publ.-73; AD-460359)

The agenda; action items; remarks of general interest; subcommittee reports on performance, design and evaluation; committee reports on program inventory and program integration; publications and future meetings; and attendance are given for the working group on design automation. Also, presentations are included on the following: (1) system reliability; (2) computer techniques applied to propulsion system performance and design; and (3) Mass II computer program. E.E.B.

N65-22109# United Technology Corp., Sunnyvale, Calif.
FOURTH-STAGE SCOUT ROCKET MOTOR PROGRAM Semimonthly Progress Report, 1–15 Jan. 1965
C. M. Frey 22 Jan. 1965 8 p
(Contract AF 04(695)-588)
(UTC-2100-SMPR16)

Test conditions and data are given for the firing of the first preliminary flight rating test motor. Four motors were processed, conditioned to a low temperature of 35° F, leak checked, and radiographically inspected. Temperatures ranging from 400° to 500° F were reached in two small areas approximately 1 in. wide and 7 in. long immediately forward of the aft insulator. Thermocouples located adjacent to these areas recorded peak temperatures of 380° and 404° F. E.E.B.

N65-22110# Aerojet-General Corp., Sacramento, Calif.
PRODUCTION OF WING VI MINUTEMAN SR 19-AJ-1 SECOND-STAGE MOTORS. WEAPON SYSTEM 133B Second Quarterly Report, Sep.–Nov. 1964
R. D. Burleson 30 Dec. 1964 23 p
(Contract AF 04(694)-501)
(Rept.-0162-06QP-2)

Status of numerous projects in production of Wing VI Minuteman SR19-AJ-1 second-stage motors, spare parts, and aerospace ground equipment in support of weapons system 133B, are described. Schedules are posted for major milestones through completion of the first three Wing VI Minuteman second-stage production motors, and for motor manufacturing and deliveries, including line-loss and quality-assurance motor requirements. The current procurement plan for major motor components is presented. Engineering change proposals for design changes in Minuteman SR19-AJ-1 second-stage motors are summarized. Contract change notifications are listed; a production analysis graph and a monthly schedule and delivery chart are shown. J.M.D.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-21192# International Geophysical Year World Data Center C2, Tokyo (Japan). Cosmic Ray Lab.
COSMIC-RAY INTENSITY DURING THE POST INTERNATIONAL GEOPHYSICAL COOPERATION NO. 9: BI-HOURLY NEUTRON AND MESON INTENSITY, JANUARY 1–DECEMBER 31, 1962

Oct. 1964 115 p

Data of cosmic rays obtained by means of a neutron monitor, a counter telescope, and three ionization chambers, which were installed at three stations in Japan during 1962, are presented. Data are classified into 13 components according to the kind of apparatus and the incident angle of acceptance. Author

N65-21228*# National Aeronautics and Space Administration, Washington, D. C.
SCATTERED AND TOTAL SOLAR RADIATION UNDER VARIOUS CONDITIONS [RASSEYANNAYA I SUMMARNAYA SOLNECHNAYA RADIATSIYA PRI RAZLICHNYKH USLOVIYAKH]
B. M. Gal'perin and L. P. Seryakova Apr. 1965 20 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 96–109
(NASA-TT-F-323) CFSTI: HC $1.00/MF $0.50

An investigation was made of the effect of shape and number of clouds as well as of the state of the solar disk on the intensity of scattered and total solar radiation. The results may be used to evaluate the incident radiation for various altitudes of the sun and under various meteorological conditions. Author

N65-21300*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF THE APPLICATION OF PERCEPTRONS FOR PREDICTION OF SOLAR FLARES. SOLAR FLARE FORECASTING WITH A RECOGNIZING AUTOMATON
Final Report, Phase II
C. M. Theiss and A. E. Murray Feb. 1965 65 p refs
(Contract NAS5-3825; Proj. Prep)
(NASA-CR-57992; CAL-VS-1945-X-1) CFSTI: HC $3.00/MF $0.75

A multiple factor classification technique, of a sort resembling learning machines, was experimentally applied to forecasting solar flares likely to have produced proton showers in the interplanetary space. Type IV radio emission was used as a criterion for this likelihood, since (1) the two phenomena are highly correlated, and (2) the radio emission is likely to be detected although the high energy protons may not reach the earth. In Phase I, a forecast accuracy of 77% was achieved in predicting the occurrence of spectral type IV flare within a given region of the sun. In Phase II, effort was concentrated on refining both the data and the experimental method. Author

N65-21306*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Research Div.
A MODEL FOR A BROAD, DISORDERED TRANSITION BETWEEN THE SOLAR WIND AND THE MAGNETOSPHERE
W. Bernstein, R. W. Fredricks, and F. L. Scarf Jul. 1963 16 p refs
(Contracts NASw-698; AF 49(636)-886)
(NASA-CR-57827) CFSTI: HC $1.00/MF $0.50

The existence of a trapped plasma which forms exterior to the initial Chapman–Ferraro sheath, as this sheath relaxes, is postulated. A model for a broad disordered transition between the solar wind and the magnetosphere is presented which describes a plausible source for the observed distribution of trapped particles in the disordered region. This model is based upon the following physical conjectures: (1) There exists a broad fluctuating region with hot electrons in the presence of an appropriate trapped particle distribution. (2) The inner boundary of the sheath is determined by specular reflection of the high-energy tail in the solar wind, while the outer boundary is determined by the maximum extent of the trapped particle distribution. (3) Some electrons attain drift speeds leading to a local double-stream instability, the consequence of which is the thermalization of the drift energy, yielding hot electrons. The high temperature achieved by these electrons acts to limit the growth of this instability, but an unstable equilibrium configuration results. L.S.

N65-21326*# General Dynamics/Astronautics, San Diego, Calif.
[EXPERIMENTS TO EXAMINE THE PREDICTABILITY OF SOLAR DATA WITH EMPHASIS ON FLARES] Fourth Bi-Monthly Progress Report, 3 Dec. 1964–3 Feb. 1965
[1965] 15 p ref
(Contract NAS5-3907)
(NASA-CR-57953; GD/A-DBA-64-009-2) CFSTI: HC $1.00/MF $0.50

A series of pilot experiments were conducted to examine the predictability of solar flare data. In the first computer program, a magnitude-of-the-difference error-weight payoff matrix was used to predict the importance of each next flare based upon the importance of the preceding flares and their temporal order, with the penalty for incorrect predictions being equal to the magnitude of error. The second program was run to predict the data from the first program on the basis of the maximum marginal probability, the maximum first-order conditional probability, the maximum second-order conditional probability and any of these, with the program choosing the one with the highest score up to that time. On 300 predictions, the second experiment showed scores of about 56% correct predictions vs 57.7% for the first experiment. Other experiments in which the error-cost matrix reflected a linear weighting in favoring the more important flares, and in which a penalty of 0.01 was used together with the error-cost matrix were conducted. The error-cost matrix adjustment demonstrated a significant improvement in that the predominance of the least importance flares is mitigated as a factor in determining the sequence of predictions. An effort to assemble a suitable data base that was already assembled ran into difficulties. L.S.

N65-21474*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
NASA SPACE RADIATION EFFECTS LABORATORY
John Duberg and Emanuel Rind [1962] 21 p refs Presented at the Symp. on Protection against Radiation Hazards in Space, Gatlinburg, Tenn., 5–7 Nov. 1962
(NASA-TM-X-51689) CFSTI: HC $1.00/MF $0.50

The proposed Space Radiation Effects Laboratory will provide the necessary facilities for conducting an expanding radiation effects research program using particulate radiation which simulates the space spectrum. To achieve these results in a minimum time, a 600-Mev. proton, synchrocyclotron of proven design with variable energy and variable external beam size, as well as a 1- to 30-MeV electron accelerator with the same capabilities have been incorporated into the proposed facility. Although these devices will be used as engineering tools, provision has been made to maintain the basic research capabilities of these accelerators. The plan reflects the latest advances in the state-of-the-art as it pertains to both the engineering and basic experimental requirements in flexibility, radiation background levels, shielding, and isolation. Author

N65-21489# National Aeronautical Lab., Bangalore (India).
CYCLIC PERIODS OF TRAPPED PARTICLES
K. S. Viswanathan and P. Venkatarangan Aug. 1964 13 p refs
(TN-PH-3-64)

Expressions have been derived for the corrections to the gyrofrequency, the bounce and drift periods of the Van Allen particles arising from the nondipole terms of the earth's magnetic field. Author

N65-21594 Paris Observatory, Meudon (France).
ON THE TEMPERATURE OF RADIATIVE EQUILIBRIUM IN A LAYER OF OPTICALLY THIN GAS IN THE RADIATION FIELD OF THE SOLAR PHOTOSPHERE
R. Cayrel *In* Smithsonian Astrophys. Obs. Proc. 1st. Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 169–174 refs (See N65-21575 11-30)

It is generally accepted that in a stellar atmosphere model in radiative equilibrium, the temperature varies in a monotonic fashion in the sense of a continuous decrease with decreasing depth, the temperature tending asymptotically toward a limiting value T_0 at the surface of the star. It is shown that this conception is not valid even with the hypothesis of local thermodynamic equilibrium where, as a result of the decrease of pressure with depth, the absorption changes in the upper layers of the atmosphere. Also, the temperature may not be monotonic in the more realistic hypothesis of statistical equilibrium. Changes in the surface temperature due to changing the absorption in LTE, and to a change of the mechanism controlling the concentration of the absorbing ions are discussed. E.E.B.

N65-21602 Sterrewacht Sonnenborgh, Utrecht (Netherlands).
THE UTRECHT REFERENCE MODEL OF THE PHOTOSPHERE
J. R. W. Heintze, H. Hubenet, and C. de Jager *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 239–245 refs (See N65-21575 11-30)

A three-column model, consisting of hot upward-rising gases, cold downward-sinking gases, and average stationary columns is discussed. As a function of the gas pressure for each of the three columns the absolute temperature, the total pressure, the electron pressure, and the optical depth are given. Also, the upward and downward convective motion component and the microturbulent velocity component are given. The relations between the gas pressure and the electron pressure, and the absorption coefficients were taken from the Bode tables and are based on the Vardya mixture of the elements. In deriving the scale of heights, the contribution of the turbulent pressure to the total pressure was taken into account. Finally, the total pressure values apply only to the average column but within the published accuracy of the values they also apply to the other columns. E.E.B.

N65-21603 State Univ. of Iowa, Iowa City.
THE CENTER-TO-LIMB VARIATIONS IN THE FAR-ULTRAVIOLET CONTINUUM
Satoshi Matsushima *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 246–252 refs (See N65-21575 11-30)

The center-to-limb variations of the ultraviolet continuum observed in rocket spectra were determined quantitatively, and the result applied to an empirical determination of the continuous absorption coefficient. The observational data used in the analysis consisted of two different sets of spectra taken at separate Aerobee-type rocket flights. The following general characteristics were revealed by the limb-to-limb tracings of the far-ultraviolet spectra: (1) The degree of limb-darkening gradually decreased down to the region λ1550 where the intensity curve becomes completely flat. (2) A sudden change from limb darkening to brightening takes place near λ1520. (3) The intensity rise to the limb decreases slightly and becomes nearly flat at λ1420. (4) Beyond λ1420 the limb brightening appears conspicuous again toward the region of the Lyman-α wing. It was also noted that the series limit of Si I falls at λ1523. These observations clearly indicated that the photospheric surface is so opaque for the far-ultraviolet continuum (λ1500) that the observed radiation is essentially chromospheric. E.E.B.

N65-21605 Belgian Royal Observatory, Uccle.
THE COMPUTATION OF SPECTROSCOPIC DATA FOR 60 NEW MODEL PHOTOSPHERES
C. De Jager and L. Neven *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 269–292 refs (See N65-21575 11-30)

There are some indications that at least certain photospheres are not completely in radiative equilibrium. The deviations from the constancy of flux can not yet be predicted theoretically; hence an empirical approach seems appropriate. The theoretical spectra for 110 models, which constitute together a 3-dimensional network with parameters T(eff), g, and the value of $dT/d\tau$ in the outer layers are being computed. Some problems discussed are: (1) For 70 lines the equivalent widths will be computed with a revised method of weighting functions. (2) For hot stars the source functions are computed iteratively, taking the influence of continuous scattering into account. (3) The detailed profiles of $H\gamma$ and $H\delta$ were computed on the basis of the theory of Kolb, Griem, Shen; the obliterating influence of thermal doppler effect was taken into account. Author

N65-21636*# Consultants and Designers, Inc., Arlington, Va.
HORIZONTAL PROPAGATION OF VELOCITY OSCILLATIONS OBSERVED ON THE SOLAR DISK [PROPAGATION HORIZONTALE DES OSCILLATIONS DE VITESSE OBSERVEES SUR LE DISQUE SOLAIRE]
Pierre Mein 19 Apr. 1965 5 p refs Transl. into ENGLISH from Copt. Rend. Acad. Sci., Groupe 3-Phys. Solaire, v. 260, 15 Feb. 1965 p 1867–1869
(Contract NAS5-3760)
(NASA-TT-F-9667; ST-SP-10318) CFSTI: HC $1.00/MF $0.50

An attempt is made to relate the measurements of the macroscopic field of radial velocities to the diagnostic diagram of hydrodynamics by two-dimensional harmonic analysis. The distinction between the traveling waves and convective flows is thereby facilitated. Author

N65-21659*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BIBLIOGRAPHY OF PARTICLES AND FIELDS RESEARCH
W. N. Hess, G. D. Mead, and M. P. Nakada Jan. 1965 88 p refs
(NASA-TM-X-55192; X-640-65-37) CFSTI: HC $3.00/MF $0.75

N65-21665*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIO EMISSION FROM SHOCK WAVES AND TYPE II SOLAR OUTBURSTS
Derek A. Tidman Feb. 1965 16 p refs
(NASA-TM-X-55200; X-641-65-68) CFSTI: HC $1.00/MF $0.50

A model for Type II solar radio outbursts is discussed. The radiation is hypothesized to originate in the process of collective bremsstrahlung emitted by nonthermal electron and ion density fluctuations in a plasma containing a flux of

energetic electrons. The source of radiation is assumed to be a collisionless plasma shock wave rising through the solar corona. It is also suggested that the collisionless bow shocks of the earth and planets in the solar wind might be similar but weaker sources of low-frequency emission with two-harmonic structure similar to Type II emission. Author

N65-21670*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEARCH FOR GAMMA-RAY POINT SOURCES
C. E. Fichtel and D. A. Kniffen Mar. 1965 26 p refs
(NASA-TM-X-55209; X-611-65-122) CFSTI: HC $2.00/MF $0.50

A search for point sources of gamma rays has been made using oriented nuclear emulsions flown on high-altitude balloons. The energy range examined was from 10 to 2×10^3 MeV, with the detection efficiency in the 10- to 50-MeV region averaging about 10% which is almost a factor of 10 greater than previous experiments with counter systems. No measurable flux of gamma radiation was observed for the regions of the sky examined, which included Cygnus A, the Spiral Arm In, Taurus A, Gemini, the Sun, and the Galactic Anticenter. A summary of the results of this and other experiments and theoretical considerations strongly suggest the need for further research in gamma-ray astronomy. Author

N65-21671*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORIGIN OF SOLAR FLARES AND THE ACCELERATION OF CHARGED PARTICLES
Donat G. Wentzel (Michigan Univ.) [1963] 33 p refs
(NASA-TM-X-55211; X-640-63-204) CFSTI: HC $2.00/MF $0.50

Theories on the origin of optical flares and the acceleration of charged particles directly due to flares are discussed. Problems related to the energy supply, magnetic energy storage, and to the rate of dissipation of solar flares are emphasized within the framework of hydromagnetics, and the mechanisms are summarized. In addition, the original discharge theory ascribing the heating of the flare region to electrons which had been accelerated in electric fields; a theory which proposes acceleration of protons to cosmic-ray energies by betatron acceleration; and Fermi's acceleration "magnetic wall" theory is discussed. The flaw in all of these theories is that each explains only one type of particle. A theory is still needed which will explain at least several of the many phenomena associated with flares. L.S.

N65-21699# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
ON A SOLAR FLARE MODEL AND ITS LABORATORY EXPERIMENTATION
K. T. Yen Apr. 1965 26 p refs
(Doc.-R65SD8)

A theoretical model for solar flares is presented to describe the physical processes considered likely to occur in the solar atmosphere above a complex sunspot group leading to the formation and development of a solar flare. Based on the idea that the strong magnetic fields of large sunspots play the dominant role in these processes, a bipolar sunspot group is considered in some detail to show how a very strong magnetic compression can take place to accumulate enough energy to form a solar flare. Estimates of the time scales for solar plasma confinement and the containment of neutral hydrogen atoms are made to show the proposed model to be a feasible one. Physical conditions favorable to the formation of solar flares and the relationship of flares to prominences and filaments are discussed. A laboratory experiment is outlined to verify the validity of the proposed model, and to investigate, within the limitations of laboratory simulation, the physical phenomenon following the flash phase of a flare. Author

N65-21718*# Florida State Univ., Tallahassee. Radio Astronomy Observatory
RADIO ASTRONOMY PROGRAMME Status Report No. 6 (Final), Aug. 1, 1964–Jan. 31, 1965
C. H. Barrow [1965] 50 p refs
(Grant NSG-224-61)
(NASA-CR-62206) CFSTI: HC $2.00/MF $0.50

Radio observations of Jupiter have been in progress at all stations operated by the Florida State University Radio Observatory throughout most of the period of the present report. Further polarization observations have been made at Tallahassee. A complete series of 18 Mc/s observations has been collected from the north–south line of five stations. The study of solar–Jupiter relationships has been continued and there is evidence of a possible correlation between major Jupiter events and solar M-region storms. Further statistics on the 1963 polarization observations were compared with the predictions of the doppler-shifted cyclotron theory. Author

N65-21786*# National Aeronautics and Space Administration, Washington, D. C.
SOLAR PLASMA EXPERIMENT
Herbert L. Bridge, Alan Lazarus (MIT), and Conway W. Snyder (JPL) 19 Apr. 1965 5 p Presented at the 46th Conv. of the Am. Geophys. Union, Washington, D. C., 19 Apr. 1965
(NASA News Release-65-117-A) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration describes the shock wave produced by the "solar wind" on earth's magnetic field at a distance of about 138 000 miles from the earth. The solar plasma probe aboard Mariner IV began to measure a plasma energy spectrum at this altitude that is characteristic of interplanetary space. Additional changes in the plasma spectrum at 145 000 and at 154 000 miles during the first 24 hours of the mission indicated shock passages, showing that the shock expanded and moved out beyond the spacecraft and that later Mariner passed through it. The solar plasma probe instrument consists of a collector cup, a high voltage power supply, and circuitry for an output signal. This probe measured the solar wind at 32 energy bands within a range of 30 to 10 000 electron volts and was able to separate the hydrogen and helium components of the plasma accurately. Due to failure in the instrument's high voltage circuitry there were no quantitative results, but it is believed that the density of the solar plasma outside of earth's orbit decreases as the distance from the sun increases. G.G.

N65-21853*# National Aeronautics and Space Administration, Washington, D. C.
MARINER IV INTERIM SCIENCE FINDINGS, NEWS CONFERENCE News Release
19 Apr. 1965 61 p Available from the Scientific and Technical Information Division

Brief summaries on the status of the Mariner IV experiments were presented by each experimental group during this National Aeronautics and Space Administration news conference. The mission to Mars was reviewed from the aspects of trajectory and the sequence of flight events, and an outline

of the spacecraft and its instruments was given. Results of the solar plasma probe which measured the properties of the gas between the planets, the three experiments that measured high energy charged particles of the cosmic rays as they affect the man on the street, the cosmic ray telescope studies, measuring of energy particles by the ion chamber, and the cosmic dust detector for observations on the micrometeorites in interplanetary space are discussed. G.G.

N65-21965*# National Aeronautics and Space Administration, Washington, D. C.
SCIENTIFIC FINDINGS FROM EXPLORER VI
Homer E. Newell 1965 377 p refs
(NASA-SP-54) GPO: HC $2.25; CFSTI: MF $2.00

Papers are given on astronomy and celestial mechanics, ionospheric physics, and energetic particles in magnetic fields. For individual titles see N65-21966–N65-21998.

N65-21975* Minnesota Univ., Minneapolis. School of Physics
INTRODUCTION TO THE ION CHAMBER AND GEIGER COUNTER EXPERIMENTS DESIGNED BY THE UNIVERSITY OF MINNESOTA
J. R. Winckler *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 105–106 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The contours of constant counting rate and radiation dosage as measured onboard Explorer VI are reported. As indicated by the nearly constant ratio of ionization chamber to Geiger counter rates, the spectrum of trapped particles in the outer zone to which the detectors are sensitive did not change appreciably down magnetic lines of force except at low altitudes. The counting rates were then used to determine the pitch-angle distributions of the trapped particles by studying the intensity down force lines. Large rate changes observed in the outer radiation region were correlated with solar activity by having a time delay indicating that the coupling was by means of solar plasma streams. Also, evidence of the lowering of mirror points in the outer zone during magnetically disturbed periods was obtained. Further, the simultaneous measurement of low energy radiation at 42 000 km on an electron shell connecting an aurora suggests that the aurora is associated with a disturbance extending over many degrees of longitude and out to large ranges. E.E.B.

N65-21976* Minnesota Univ., Minneapolis. School of Physics
OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959, PART 1
R. L. Arnoldy, R. A. Hoffman, and J. R. Winckler *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 107–125 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00
(Contract NASw-56)

An integrating ionization chamber and a single Geiger counter were flown on United States satellite Explorer VI in an elliptical orbit extending to 48 000 km. In addition to the Van Allen inner zone and the great outer zone, a stable and distinct intermediate zone was detected throughout August and September 1959. The outer-zone intensity showed a large decrease following the sudden commencement of a geomagnetic storm. Later in the storm the outer zone increased to much in excess of its prestorm level. During stable periods the outer zone was fairly constant and less intense than it had been observed to be with Pioneer III or Pioneer IV or the first Soviet cosmic rocket. Cosmic-ray background counting rates were reached on most passes in August and September near apogee of the satellite. The radiation dumped from the outer zone during the geomagnetic storm fits very well with the intensity and latitude distribution required to account for balloon observations of auroral X-rays made during the IGY period. Author

N65-21977* Minnesota Univ., Minneapolis. School of Physics
OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 2: THE CAPETOWN ANOMALY AND THE SHAPE OF THE OUTER BELT
Robert A. Hoffman *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 126–129 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

This paper shows that any particles affected by the Capetown magnetic anomaly do not have trajectories that would pass through the position of the experimentally observed minimum in the outer belt. Therefore, the minumum cannot be taken as evidence either for the effect of the anomaly on the trapped radiation or for support of the neutron albedo source for the outer zone electrons. Author

N65-21978* Minnesota Univ., Minneapolis. School of Physics
OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 3: THE INNER BELT
R. A. Hoffman, R. L. Arnoldy, and J. R. Winckler *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 130–142 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The differential energy spectrum of an assumed power law form for trapped protons in the inner belt was determined from data received from the ion chamber and Geiger counter aboard the earth satellite Explorer VI. Above an energy of 30 MeV, the spectrum has the form of $E^{-1.65}$ at about −28° geomagnetic latitude. The spectrum was checked by comparison of the actual proton counting rate of the triple coincidence telescope aboard Explorer VI in the inner belt with the rate calculated from such a spectrum. It is shown that the counting rate from the scintillation counter aboard Explorer VI is probably due primarily to electrons. Electron fluxes at the maximum of the inner belt are given as about 2×10^9 electrons/cm^2 sec from 200 to 500 keV, or about 1×10^7 electrons/cm^2 sec greater than 500 keV at −28° geomagnetic latitude. The spectra obtained are shown to be in agreement with those previously published, and not in conflict with the spectrum calculated from neutron albedo decay. Author

N65-21979* Minnesota Univ., Minneapolis. School of Physics
OBSERVATION OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 4: THE OUTER-ZONE ELECTRONS
R. L. Arnoldy, R. A. Hoffman, and J. R. Winckler *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 143–161 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

A study is reported of the data from the radiation detectors aboard the Explorer VI earth satellite (1959δ_1, launched August 7, 1959) as the spacecraft passed through the outer zone during a period when the count rate time variations and the geomagnetic activity were low. The radiation detectors aboard the satellite were an ionization chamber, a Geiger counter, a proportional counter telescope, and a scintillator. Extensive calibrations were made to determine the response of these detectors to monoenergetic electrons when inside a spare payload. In using these calibrations and fitting assumed power-law spectra of electrons to the data, it is seen that the spectrum is flat and must extend to several MeV at the small ranges, with the

ion chamber and Geiger counter responses there due primarily to direct electron detection. The intensity of the energetic electrons is shown to decrease with increasing range as the spectra steepen and the radiation softens, resulting in an increasing contribution of bremsstrahlung to the rates of the chamber and Geiger counter. This analysis is only capable of fitting trial spectra to the data; the procedure does not eliminate the possibility of more complex spectra existing in the outer zone which would lead to different conclusions about the nature of the trapped radiation. Author

N65-21980* Minnesota Univ., Minneapolis. School of Physics
OBSERVATIONS ON THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 5: VISUAL AURORAS, HIGH-ALTITUDE X-RAY BURSTS, AND SIMULTANEOUS SATELLITE OBSERVATIONS
R. L. Arnoldy, R. A. Hoffman, J. R. Winckler, and S. I. Akasofu (Alaska Univ.) *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 162–178 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The measurements made in the outer trapped radiation region by an ionization chamber, a Geiger counter, and a scintillation counter aboard the Explorer VI earth satellite during the August 16, 1959, magnetic storm are studied. The variations in the detector rates are correlated with the visual aurora recorded by all-sky cameras and with high-altitude X-ray bursts observed by balloonborne detectors. An increase in radiation observed at a geocentric range of 42 000 km simultaneously with the occurrence of a visual aurora on the electron shell connecting with the satellite measurements suggests that the aurora is associated with a disturbance extending over many degrees of longitude and out to large ranges. A rapid decrease in the Geiger counter rate coincident with a strong low-latitude aurora at Fargo, North Dakota, indicates that energetic radiation is either precipitated out of the outer zone during strong auroras or decelerated by a perturbation of the earth's magnetic field accompanying the aurora. Frequent observations of rate variations, at the outer edge of the trapped radiation and at apogee, point out the great instability there that results in the frequent discharge of radiation into the atmosphere observed by balloonborne detectors at the high latitudes connecting with the region. The close correlation of outer-zone intensity variations and solar phenomena indicates that the energy involved in the dynamics of the trapping region has a solar origin. Author

N65-21981* Minnesota Univ., Minneapolis. School of Physics
OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 6: PROPERTIES OF THE OUTER REGION
R. A. Hoffman, R. L. Arnoldy, and J. R. Winckler *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 179–209 refs (See N65-29165 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The results are summarized of measurements with ion chamber and Geiger counter instruments aboard the Explorer VI satellite; the general intensity, structure, and shape of the outer radiation region as displayed by contours of constant counting rate from a Geiger counter are discussed. These contour plots show the large variation in counting rate, volume, and structure to which the outer radiation region is subjected during magnetic activity. Frequently two maximums are observed in the outer zone. It is shown that the depth of the minimum between these maximums as a function of altitude is an argument against any earth surface magnetic anomaly as the cause of the minimum in intensity. By using the Geiger counter rate along a magnetic line of force, together with the ionization rate ratio, to determine the constancy of the spectrum, pitch-angle distributions at the equatorial plane are derived. The equatorial pitch-angle distribution is unfolded by means of a form of Abla's integral equation with a mathematical approximation to the counting rates as a function of magnetic field strength. The pitch-angle distribution is derived before and after a large magnetic storm. Finally, a discussion of properties of the outer radiation zone during magnetically quiet times and the changes associated with a series of magnetic storms during August and September are discussed in detail. It is concluded that major intensity changes always correlate with solar activity, a time delay indicating the coupling by means of solar plasma beams. Author

N65-21982* Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies
INTRODUCTION TO THE COSMIC AND TRAPPED RADIATION STUDIES DESIGNED BY THE UNIVERSITY OF CHICAGO
C. Y. Fan, Peter Meyer, and J. A. Simpson *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 213–214 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Studies of the trapped radiation in the magnetosphere and experimental tests for resolution of cosmic-ray modulation theories are reported. The most important conclusion drawn from the experiments of trapped radiation in the magnetosphere was that the changes in the outer electron belt intensity and energy spectrum were taking place irreversibly and, hence, that local acceleration of the electrons is almost certainly required. Also, the flux and energy distribution of electrons in the outer belt was closely correlated to changes in the geomagnetic field. Since these magnetic field changes were brought about by geomagnetic storms, it followed that the solar wind provided the energy input to the magnetosphere. Further, a sharp reduction in cosmic-ray intensity was simultaneously observed near the apogee of Explorer VI and at neutron intensity monitors on the earth's surface. It was thereby proved that the Forbush decreases could be seen in interplanetary space independent of the earth's system. E.E.B.

N65-21983* Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies
COSMIC RADIATION INTENSITY DECREASES OBSERVED AT THE EARTH AND IN THE NEARBY PLANETARY MEDIUM
C. Y. Fan, Peter Meyer, and J. A. Simpson *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 215–218 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Preliminary experiments prove the existing theories for the modulation mechanism responsible for rapid decreases of primary cosmic-ray intensity cannot involve the presence of the earth or its magnetic field. The experiment excludes existing hypotheses which invoke the presence of the earth and the geomagnetic field to account for the Forbush decreases of cosmic-ray intensity. Thus, geocentric models such as solar plasmas containing disordered magnetic fields overlying the geomagnetic field, or the roughing-up of the geomagnetic field by a solar wind do not account for the observations reported. However, the sharp intensity decreases at the earth are the delayed consequences of large solar flare outbursts on the visible side of the sun. Forbush decreases are observed at the earth only for restricted angular positions of the solar events relative to the position of the earth. Therefore, the modulation region may be confined to a volume of space surrounding the Sun–Earth line. E.E.B.

N65-21984* Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies

EXPERIMENTS ON THE ELEVEN-YEAR CHANGES OF COSMIC-RAY INTENSITY USING A SPACE PROBE

C. Y. Fan, Peter Meyer, and J. A. Simpson *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 219–221 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Experiments prove that any mechanism changing the cosmic-ray intensity over 11 years is centered about the Sun, and the scale size is greater than one astronomical unit for the volume of space in which the cosmic-ray intensity is reduced at the period of the solar activity maximum. It was also found that the gradient of cosmic-ray intensity near the orbit of the Earth is so small as to suggest that modulation of galactic intensity occurs at distances much greater than the orbit of the Earth. The experiment consisted of carrying cosmic radiation detectors from the Earth to great distances in interplanetary space near the time of solar maximum. The detector measured protons above 75 MeV and, hence, integrated over that part of the cosmic-ray spectrum between solar maximum and solar minimum. E.E.B.

N65-21985* Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies

DYNAMICS AND STRUCTURE OF THE OUTER RADIATION BELT

E. Y. Fan, Peter Meyer, and J. A. Simpson *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 222–256 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

From an analysis of electron measurements in the Explorer VI satellite (August 7–October 6, 1959) four time-dependent parameters which characterize the outer electron belt were investigated. They are: (1) the equatorial electron intensity I_0; (2) the equatorial range from the earth R_0 of the peak intensity; (3) the electron-density distribution along a line of force through the intensity peak; and (4) a measure of the change in electron spectrum with time. Several magnetic storms occurred during the observation on Explorer VI. Within the sequence of changes in the outer belt induced by these geomagnetic storms, there are some changes of the parameters which are accounted for only by invoking an irreversible energy gain or loss within the outer belt. The energy gain process appears to be through irreversible local acceleration of electrons. The energy loss process leads to a stable mirror-point distribution characteristic of the periods between geomagnetic storms. The time intervals within which each of these processes is operative are identified. Author

N65-21986* California Univ., Berkeley. Lawrence Radiation Lab.

THE OBSERVED OUTER-BELT ELECTRON DISTRIBUTION AND THE NEUTRON DECAY HYPOTHESIS

W. N. Hess, J. Killeen, C. Y. Fan, P. Meyer, and J. A. Simpson (Chicago Univ.) *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 257–259 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Measurements of electron flux along a line of force in the outer radiation belt are compared with calculations that assume that all electrons are injected by neutron decay. The comparison shows that the two distributions are quite different at intermediate and low latitudes where corrections are unimportant. It is concluded that other processes, in addition to electron injection by neutron decay, are necessary to explain the experimentally observed flux distribution along a line of force. Author

N65-21987* Space Technology Labs., Inc., Redondo Beach, Calif.

INTRODUCTION TO THE SCINTILLATION COUNTER EXPERIMENTS DESIGNED BY SPACE TECHNOLOGY LABORATORIES, INC.

T. A. Farley *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 263–264 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Observations of the particle intensity immediately following the sudden commencement of a geomagnetic storm by scintillation counters are discussed. Also, the correlations of the particle intensity with the magnetic field as measured by the magnetometer onboard Explorer VI are reviewed. Further, a broad survey of scintillation counter data, together with detailed description of the instrument and the corrections applied to data for saturation and binary failure effects, is presented. In the calculation of the geometric factor an error was made. The geometrical factor should be a factor of 4 larger. Consequently, all the reported fluxes (except for high energy cosmic rays) presented with these data should be reduced by a factor of 4. E.E.B.

N65-21988* Space Technology Labs., Inc., Redondo Beach, Calif.

CHARGED-PARTICLE VARIATIONS IN THE OUTER VAN ALLEN ZONE DURING A GEOMAGNETIC STORM

T. A. Farley and A. Rosen *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 265–268 refs Also published in J. of Geophys. Res., Oct. 1960 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

A detailed comparison was made between the scintillation counter rate and the magnetometer onboard the same vehicle. Results showed a number of intervals, covering a considerable period of time in each case, in which the magnetic field gave a good in-phase correlation with the scintillation counter, thereby demonstrating the existence of the betatron-type mechanism. However, the fluctuations during the geomagnetic storm showed an out-of-phase correlation. These observations indicated that there is a magnetic field, associated with the particles seen by the scintillation counter, which is capable of reducing the geomagnetic field. The phenomena described are consistent with the geomagnetic storm model of Dessler and Parker. Also, confirmation of the increase of energetic protons in the geomagnetic field during a strom makes plausible the establishment of the field stresses which account for the main phase of a geomagnetic storm in the model. E.E.B.

N65-21989* Space Technology Labs., Inc., Redondo Beach, Calif.

PITCH ANGLE DISTRIBUTIONS AND MIRROR POINT DENSITIES IN THE OUTER RADIATION ZONE

T. A. Farley and N. L. Sanders *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 269–278 refs Also published in J. Geophys. Res., Jun. 1962 (See N65-21965 10-29) GPO: HC $2.25; CFSTI: MF $2.00

A method is presented for the calculation of the equatorial pitch angle distribution (unidirectional intensity distribution) of trapped radiation from the count rate of an omnidirectional detector along a line of force. An expression is derived for the calculations of the mirror point density from the equatorial pitch angle distribution. The method is applied to data obtained from a scintillation counter and a proportional counter on the Explorer VI satellite. The results from the scintillation counter show a relative absence of electrons with pitch angles of 90° during quiet periods, a sharp increase in such particles shortly after a sudden commencement magnetic storm, and restoration of the prestorm distribution at a higher intensity

level after the storm. The results from the proportional counter are qualitatively similar with the exception of the apparent deficiency of 90° pitch angles during quiet periods, which does not appear. Author

N65-21990* Space Technology Labs., Inc., Redondo Beach, Calif.
CHARACTERISTICS OF THE VAN ALLEN RADIATION ZONES AS MEASURED BY THE SCINTILLATION COUNTER ON EXPLORER VI
Alan Rosen and Thomas A. Farley *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 279–296 refs Also published in J. Geophys. Res., Jul. 1961 (See N65-21965 11–29) GPO: HC $2.25; CFSTI: MF $2.00

A scintillation counter responding principally to direct electrons has been flown on the Explorer VI earth satellite in an elliptical orbit extending to 48 600 km. The instrument measured fluxes of electrons above 200 keV and protons above 2 MeV. After a week of magnetically quiet observations, a geomagnetic storm occurred, and an immediate increase in the counting rate of this instrument was detected; other radiation instruments showed a decrease in counting rate at this time. Gross fluctuations in particle intensity were observed at the edge of the outer zone of the Van Allen radiation belt during the storm, and these fluctuations are closely related to simultaneous geomagnetic activity. The increased particle intensity in the outer zone declined quite slowly after the storm until the next period of magnetic activity. This paper presents a detailed summary of the observations made by the scintillation counter during the period of data reception from the satellite. Author

N65-21997* Space Technology Labs., Inc., Redondo Beach, Calif.
THE EFFECTS OF BETATRON ACCELERATIONS UPON THE INTENSITY AND ENERGY SPECTRUM OF MAGNETICALLY TRAPPED PARTICLES
Paul J. Coleman, Jr. *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 347–357 refs Also published in J. Geophys. Res., May 1961 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

A system composed of relativistic, charged particles in a uniform, slowly varying magnetic field is considered. The initial or unperturbed state of the system is one in which the number of particles per cubic centimeter with energies greater than E is given by $kE^{-\gamma}$, and in which the particle flux is isotropic. The effects of slow, uniform changes in the field strength upon the integral energy spectrum and upon the omnidirectional intensity of particles with momenta greater than σ are calculated. A simple expression which describes the latter effect is developed. Variations of these two effects are calculated as functions of the parameters, γ and σ. Author

N65-22106# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS AND EVALUATION OF MEASUREMENTS OF GEOMAGNETICALLY TRAPPED ELECTRONS FROM HIGH ALTITUDE NUCLEAR EXPLOSIONS Final Report
William L. Imhof, Edward E. Gaines, David R. King, George H. Nakano, Ray V. Smith et al Jul. 1964 137 p refs
(Contract DA-49-146-XZ-205)
(LSMC-3-25-64-1; DASA-1540; AD-612013)

The Starfish detonation on 9 July 1962 dramatically demonstrated, by producing significant damage to several space missions, the important military implications of geomagnetically trapped electrons. Results on the spatial distribution, spectrum, angular distribution, and time history of electrons artificially injected and trapped in the earth's field as a result of not only the Starfish detonation but also some Soviet high-altitude detonations are presented. TAB

N65-22145# Emmanuel Coll., Boston, Mass. Research Language Center
SOME PECULIARITIES IN THE BEHAVIOR OF THE F2 and SOME PECULIARITIES IN THE BEHAVIOR OF THE F2 AND F1 LAYERS OF THE IONOSPHERE OVER IRKUTSK [NEKOTORYE OSOBENNOSTI V POVEDENII SLOEV F2 I F1 IONOSFERY NAD IRKUTSKOM]
V. M. Poliakov and L. A. Shchepkin Bedford, Mass., AFCRL, Apr. 1964 14 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 1, no. 3, 1961 p 374–378
(Contract AF 19(628)-3869)
(E-T-R-64-16; AD-610996)

Certain properties of the ionization state in the F2 layer are analyzed from the diurnal variation of its critical frequencies as well as the recombination parameter α' for a quiescent state of the ionosphere. The time when the critical frequencies of the F2 layer deviate from a simple relation with the sun's zenith angle is compared with the time when the F1 layer appears. The excess ionization, which was discovered previously in the F2 layer during earlier morning hours, is discussed. Author

N65-22171*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
STUDY OF LUNAR REFLECTIVE COMPONENTS OF SOLAR RADIO EMISSION Semiannual Status Report
G. R. Cooper and C. D. Mc Gillem 28 Feb. 1965 15 p
(Grant NsG-543)
(NASA-CR-62349) CFSTI: HC $1.00/MF $0.50

The utilization of solar radio frequency emission as an energy source to measure its scattering by the lunar surface is proposed. An analysis of the involved power for a case where the moon is represented as a collection of moving scatterers was made, and the design of a digital correlator for measuring the time correlation function of the input signals is evaluated. The resolution of details on the lunar surface is directly related to the capability of the correlator to separate the various delays and delay rates. The different components of the correlator have been assembled and tested except the local oscillator and tape recorder. A block diagram of the digital correlator is shown. G.G.

N65-22192*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELDS AND SOLAR WIND
Masahisa Sugiura [1964] 15 p refs Presented at Symp. on Space "Weather", Warrenton, Va., 2–4 Apr. 1964; Sponsored by Interdepartmental Comm. for Atmospheric Sci. and the U. S. Dept. of Commerce Submitted for Publication
(NASA-TM-X-51718) CFSTI: HC $1.00/MF $0.50

The highlights in several selected topics on the interaction of solar corpuscular radiation with the geomagnetic field are discussed. The solar wind, interplanetary magnetic fields, magnetospheric boundary, heating of the upper atmosphere by the solar wind, sudden changes in solar wind pressure, and the magnetic activity indices are considered. The following were among the specific items reported. Explorer X magnetic field measurements showed that the magnetic field energy outside the magnetosphere is typically a factor of 5 to 10 less than the observed plasma energy density, and hence the magnetic field is carried by the solar wind. Also, both small and large

scale variability was observed in the solar wind. A recent magnetometer measurement indicated that the interplanetary magnetic field is typically a few to 7 gammas and has a filamentary structure. E.E.B.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-21180# Sydney Observatory (Australia).
ASTROGRAPHIC CATALOGUE 1900-0, SYDNEY SECTION, DECLINATION −51° TO −65°, VOLUME 51
Harley Wood 1964 53 p

An astrographical catalog of data from photographs taken at the Sydney Observatory from 1892 to the present is given. The photographs cover the rectangular coordinates in the region of the sky between −63° to −65° south declination, with plate centers at −64°, 12 to 18 hrs. in right ascension. L.S.

N65-21224 Library of Congress, Washington, D.C. Aerospace Technology Div.
EPHEMERIDES FOR POSITION DETERMINATIONS ON THE MOON'S SURFACE
Edward Gelins *In its* Foreign Sci. Bull., Vol. 1, No. 3, Mar. 1965 p 30–34 refs (See N65-21218 11-34) CFSTI: HC $3.00/MF $0.50

Ephemerides for lunar position determinations have been compiled, together with instructions on their use. The new term "lunar sidereal time" was introduced, and the length of the lunar sidereal hour was determined and compared with terrestrial sidereal time. A special automatic theodolite was designed for use on the lunar surface for selenographic position determinations. Author

N65-21232*# National Aeronautics and Space Administration, Washington, D.C.
THE SUPERNOVA OF 1054—A DOUBLE STAR? [SVERKHNOVAYA 1054 g.—DVOYNAYA ZVEZDA?]
I. S. Shklovskiy Apr. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 1, 1965 p 54–56
(NASA-TT-F-340) CFSTI: HC $1.00/MF $0.50

The long-accepted hypothesis that the nucleus of the Crab nebula is a remnant of the 1054 supernova is subjected to a critical reexamination in the light of recent evidence. More particularly, Kraft's data and his subsequent inference that the central star of the Crab nebula could be a common star occupying its centermost position by virture of chance are challenged on statistical grounds. The fresh hypothesis is advanced that the observed star is one member of a double system, its partner having exploded into a supernova whose remnant is not optically observable. Arguments pro and con the hypothesis are presented, but it is strongly favored by the strikingly large proper motion of the star, among other features brought under discuss on. Author

N65-21301*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
THE APPLICATION OF A NUMERICAL INTEGRATION PROCEDURE DEVELOPED BY ERWIN FEHLBERG TO THE RESTRICTED PROBLEM OF THREE BODIES
I. E. Perlin and C. P. Reed, Jr. [1963] 56 p refs
(Contract NAS8-11129)
(NASA-CR-57990) CFSTI: HC $3.00/MF $0.50

A Burroughs B-5000 Algol program was devised to implement the integration procedure. Given a set of initial conditions, there are three independent options under which the program may be executed. One option produces values of $x, y, \dot{x}, \dot{y}, t$, the step size, the Jacobi constant, the distance to the earth, and the distance to the moon at each time step for a full period. Another option is included to force an iterative procedure for improving a given set of initial conditions until an orbit is produced which is periodic within a prescribed error tolerance. Under a third option, an output magnetic tape is prepared with a content and format acceptable to the SC 4020 plotter. In this manner the coordinates of every computed point describing an orbit are plotted as well as printed. Input data for one complete orbit is supplied to the program in data sets and processed. An example orbital printout and a plot of the final orbit is shown. L.S.

N65-21317*# National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, Fla.
THE WORKING GROUP ON EXTRATERRESTRIAL RESOURCES, THIRD ANNUAL MEETING
[1964] 346 p refs Meeting held at Cocoa Beach, Fla., 18–20 Nov. 1964
(NASA-TM-X-56277) CFSTI: HC $7.00/MF $1.75

CONTENTS:

1. BUSINESS MEETING p 5–21 refs
2. PLANS FOR 1965 Ernst A. Steinhoff p 23–27
3. ENVIRONMENT AND RESOURCES SESSION p 29–47 refs
4. SOVIET LUNAR CONSTRUCTION POTENTIAL p 49–58
5. MINING AND PROCESSING SESSION p 59–159 refs
6. LOGISTICS REQUIREMENTS SESSION p 161–257 refs
7. BIOTECHNOLOGY SUBGROUP p 259–330 refs

APPENDIXES
8. ATTENDEES, WORKING GROUP ON EXTRATERRESTRIAL RESOURCES THIRD ANNUAL MEETING p 331–338
9. TECHNICAL PAPERS PRESENTED AT THE WORKING GROUP ON EXTRATERRESTRIAL RESOURCES ANNUAL MEETING, 18–20 NOVEMBER 1964 p 339–340

N65-21359# Joint Publications Research Service, Washington, D.C.
M. V. KELDYSH'S ADDRESS AT PRESS CONFERENCE ON "VOSKHOD-2" FLIGHT
M. V. Keldysh 12 Apr. 1965 6 p Transl. into ENGLISH from Izv. (Moscow), 27 Mar. 1965
(JPRS-29531; TT-65-30704) CFSTI: $1.00

An address by a Soviet official on the flight of Voskhod-2 is presented. In the March 18, 1965 flight, a cosmonaut in a special space suit left the two-man spacecraft and maneuvered up to 5 meters from the ship. The significance of this achievement in the Soviet space program is discussed. J.M.D.

N65-21388*# Bern Univ. (Switzerland).
RARE GAS MEASUREMENTS IN METEORITES AND POSSIBLE APPLICATIONS TO THE LUNAR SURFACE
Peter Eberhardt Jun. 1964 75 p Submitted for Publication
(Grant NsG-157)
(NASA-CR-62101) CFSTI: HC $3.00/MF $0.75

Rare gas measurements on meteorites are shown to be useful in determining the history of meteorites and their surroundings, and future applications of these measurements to lunar history studies are discussed. From rare gas measurements on numerous meteorites, analyses were made of radioactive decay of long-lived isotopes, spallation-produced rare gases, short-lived isotopes, fusion-produced isotopes, and trapped gases; these analyses are said to be useful in determining the time of the individual meteorite's formation, its thermal history, history of cosmic radiation, and the interval between nucleosynthetic processes and formation of meteorite parent bodies. It was concluded that most of the stone meteorites studied were formed 4.5×10^9 years ago. Radioactive age determination of lunar surface features, and of the moon itself, are discussed. Three methods are described for measuring the history of the particle radiation field in the solar system. Erosion, formation of stable and radioactive spallation isotopes, and diffusion loss, are discussed with respect to lunar surface histories. J.M.D.

N65-21403# RAND Corp., Santa Monica, Calif.
HYPERSONIC TURNING WITH CONSTANT BANK ANGLE CONTROL
F. S. Nyland Mar. 1965 50 p refs
(Contract AF 49(638)-700)
(RM-4483-PR; AD-612622)

The elements of a model are presented for predicting the turning trajectories of hypersonic reentry gliders by approximate closed form solutions. Vehicle control is assumed to be exercised by varying the angle-of-attack and bank angle. The control variables are assumed to be constant for each particular trajectory, but the lift-to-drag ratio has been varied from 1.0 to 4.0 and the bank angle has been permitted to become as large as 90°. Approximate closed form solutions are compared with earlier results of a study of minimum energy hypersonic turns. Author

N65-21475*# California Univ., La Jolla.
A STUDY OF THE VELOCITY FIELD IN M 82 AND ITS BEARING ON EXPLOSIVE PHENOMENA IN THAT GALAXY
E. Margaret Burbidge, G. R. Burbidge, and Vera C. Rubin [1964] 66 p refs Submitted for Publication
(Grant NsG-357)
(NASA-CR-56594) CFSTI: HC $3.00/MF $0.75

A detailed spectroscopic study of M 82 was carried out from spectra taken in nine different position angles, and extending about 2' from the center of the galaxy (the radius M 82 is about 4'). It appears that the gas which was blown out forms a double cone with a half-angle $\approx 20°$. The true space velocity is about 450 km/sec for the gas furthest from the center whose line-of-sight velocity can be measured. The forms of the velocity curves in position angles 0° and 145° (the position angle of the major axis of the galaxy is 62°) show that gas is observed in the exploded cones above and below the main body of the galaxy and that these obey approximately linear velocity–distance relations, while the velocity curve of the gas in the main body of the galaxy indicates that it has undergone damping and deceleration. After a review of the energetics of the outburst, it is concluded that a total energy of $\sim 10^{57}$ ergs or greater may have been released in the last few million years. Author

N65-21575# Smithsonian Astrophysical Observatory, Cambridge, Mass.
PROCEEDINGS FIRST HARVARD-SMITHSONIAN CONFERENCE ON STELLAR ATMOSPHERES
21 Dec. 1964 337 p Conf. held in Cambridge, Mass., 20–21 Jan. 1964
(SAO Special Report.-167)

Conference papers are presented on basic data for model atmospheres, nongray atmospheres, comparision of specific models, significance of uncertainties in the physical theory, and astronomical data. For individual titles see N65-21576–N65-21609.

N65-21577 Smithsonian Astrophysical Observatory, Cambridge, Mass.
REVIEW OF OPACITY CALCULATIONS
Owen Gingerich *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 17–41 refs (See N65-21575 11-30)

The procedures used to compute the opacity sources of solar and cooler models individually within a computer program, and a scheme for neutral helium are presented. Atomic hydrogen, negative hydrogen ion, quasi-hydrogen molecule, ionized helium, Rayleigh scattering, opacity of the cool and hot stars, hydrogen line wings, and metal absorptions are discussed. Further, the absorption coefficient per neutral hydrogen atom for two cool-star models; the opacity at optical depths of 0.1, and 1.0 in solar models and in an 8000° model; predicted solar continuum and ultraviolet rocket observations; calculated and observed solar fluxes; and predominant sources of monochromatic opacity per gram of stellar material as a function of frequency are given. E.E.B.

N65-21578 State Univ. of Iowa, Iowa City.
H_2^+ ABSORPTION AS A SOURCE OF CONTINUOUS OPACITY IN THE STELLAR ATMOSPHERES
Satoshi Matsushima *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 42–49 refs (See N65-21575 11-30)

It is shown that the ratio of the absorption coefficient of H_2^+ per unit mass of stellar matter to that of H^- is independent of all physical conditions in the stellar atmospheres except the temperature. Hence the relative contribution of H_2^+ as a source of continuous opacity may be estimated in terms of temperature only. Such a calculation indicates that the absorption of H_2^+ is only a few percent of that caused by H^- for the entire region of the spectrum of all the stars, except in the far ultraviolet, where H^- absorption becomes negligibly small compared to the other sources of opacity. Since the temperature distribution has been found insensitive to a change of 10% in the absorption coefficient, it is concluded that H_2^+ absorption may be ignored in the computations of atmospheric models. It may only affect the color distribution of emergent flux by a few percent. Author

N65-21579 Paris Observatory, Meudon (France).
COMPUTATION OF SOME PHOTOIONIZATION CROSS SECTIONS OF NEUTRAL CARBON
F. Praderie *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 52–55 refs (See N65-21575 11-30)

In order to determine the role of carbon as an absorber in stellar atmospheres, several photoionization cross sections of CI were calculated using the quantum defect method. This method as applied did not take account of the configuration interaction. It was assumed that the ejected electron was submitted to a central potential as if it were alone on the outer

shell of the atom (one-channel approximation). The carbon atom is complicated and no experimental results were available on the continuous absorption of carbon. In these conditions, the calculated cross sections, which are superior to the hydrogen-like values even for high initial levels of the atom, will permit calculation of the carbon continuous absorption. A table of the neutral carbon photoionization cross sections is included. E.E.B.

N65-21581 Smithsonian Astrophysical Observatory, Cambridge, Mass.
EVALUATION OF FLUX AND INTENSITY INTEGRALS
E. H. Avrett *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 63–76 ref (See N65-21575 11-30)

As one of the numerical difficulties involved in model atmosphere calculations is the evaluation of flux and mean intensity integrals, a method is described for solving the problem. Also, a table of calculated values for these two parameters for varying values of the integrated gray source function is presented. E.E.B.

N65-21582 Smithsonian Astrophysical Observatory, Cambridge, Mass.
A PROCEDURE FOR EVALUATING THE FLUX INTEGRAL
Owen Gingerich *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 77–79 (See N65-21575 11-30)

A flux evaluation procedure is described for performing a rapid full integration of the Milne equations. The procedure is not sufficiently accurate for flux accuracies of a few hundredths of a percent, and therefore a second-order approximation is required. Also, the procedure was extended to the mean intensity and limb-darkening integrals. The flux error in a gray model is a few parts in 10^5. E.E.B.

N65-21583 Paris Observatory, Meudon (France).
A PROCEDURE FOR COMPUTING THE MEAN INTENSITY AND THE FLUX
P. Feautrier *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 80–82 (See N65-21575 11-30)

The transfer equation is given in terms of an arbitrary depth variable and the associated absorption coefficient. By selection of boundary conditions and the use of certain approximations, equations are derived for the mean intensity and the flux. The method is more rapid than one consisting of the evaluation of integrals when the values of the mean intensities at a large number of points are required. If N points are desired and M values of μ are used, the classical method takes a time approximately equal to N^2, whereas this method takes a time approximately equal to NM. In general, low values of M, of the order of 3 or 4, are used. E.E.B.

N65-21584 Smithsonian Astrophysical Observatory, Cambridge, Mass.
TEMPERATURE-CORRECTION PROCEDURES
E. H. Avrett *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 83–92 (See N65-21575 11-30)

The temperature distribution in a model atmosphere such that the radiative flux is prescribed function of depth can be determined by iteration, if a procedure for correcting an assumed temperature distribution is used. The correction equation of Böhm in terms of the Planck function and the Rosseland mean optical depth is discussed as such a correction. A procedure is presented in which the source function differs from the Planck function, and in which the radiative flux is not necessarily constant with depth. E.E.B.

N65-21585 National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York.
A TEMPERATURE-CORRECTION PROCEDURE
L. B. Lucy *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 93–98 (See N65-21575 11-30)

A temperature-correction procedure used in the calculation of early-type model atmospheres is derived and discussed. The departures in such atmospheres from grayness are large, and the difficulties in obtaining models in strict radiative equilibrium are great. The method described may be regarded as a generalization to the nongray case of the method suggested by Unsöld. For actual use it is convenient to eliminate certain terms so that all the quantities of the equation are available at the completion of the n^{th} iteration, and an improved temperature distribution can be obtained with which to start the $(n + 1)^{th}$ iteration. Further, by rewriting the correction term one can derive corrections which are important near the surface and in the deeper layers. E.E.B.

N65-21586 Kiel Univ. (West Germany).
AN INTEGRAL EQUATION FOR THE TEMPERATURE CORRECTION IN A NONGRAY ATMOSPHERE
Erika Böhm-Vitense *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 99–107 (See N65-21575 11-30)

A new method is proposed to compute the temperature stratification for a nongray atmosphere from an integral equation for the temperature correction. The only basic approximation needed is the assumption $\Delta B/B_0 << 1$ ($B = \sigma/\pi \cdot T^4$), B_0 = temperature stratification in the first approximation. The approximation is needed in order to describe the change in the frequency distribution of B_ν due to the change in B by first-order terms. The change of B due to lines at different wavelengths is discussed. Author

N65-21587 Paris Observatory, Meudon (France).
A METHOD FOR IMPROVING THE T(x) LAW
P. Feautrier *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 108–110 (See N65-21575 11-30)

The equation of transfer is linearized by a temperature approximation law, taking into account the radiative equilibrium condition, to obtain an improved temperature distribution by solving the integral equation

$$\int_0^\infty K_\gamma B_\gamma(t)d\gamma = \int_0^\infty K_\gamma I_\gamma d\gamma$$

$\bar{I}$ is computed from the values of J_{ik} using the equation

$$\bar{I}_{\gamma l}(x_i) = \sum_i^M h_k J_{ikl}$$

The method is programed and applied to the standard typical model atmosphere of pure hydrogen, $T_e = 10^4$ deg K, and $g = 10^4$ cgs. E.E.B.

N65-21588 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

AN ITERATIVE SOLUTION FOR THE SOURCE FUNCTION IN THE GRAY ATMOSPHERE IN RADIATIVE EQUILIBRIUM

Kenneth Grossman *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 111–128 refs (See N65-21575 11-30)

An iterative solution for the source function in the gray atmosphere in radiation equilibrium is derived. It is shown analytically that this iteration procedure converges uniformly in the sense that the maximum error decreases with successive iterations. The method is insensitive to the initial guess; convergence is rapid for initial guesses that err by factors of 100. Author

N65-21589 Terva Univ. Observatory (Japan).

EFFECTS OF ERRORS IN THE ABSORPTION COEFFICIENT ON THE NONGRAY MODEL STELLAR ATMOSPHERES

Satoshi Matsushima and Yoichi Terashita *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 129–136 refs (See N65-21575 11-30)

Effect on the nongray model-atmosphere calculation resulting from errors of 10% to 50% in the continuous opacity is examined by constructing two solar-type model atmospheres in which different H^- absorption coefficients are used. In one model, old values of Chandrasekhar are used for both bound–free and free–free absorption of H^- are used; in the other model values recently revised by Geltman and by Ohmura are used. Values for bound–free absorption differ by 10% in the visible region, those for free–free absorption, by 40% to 50% in the infrared. Other than H^-, only neutral hydrogen is taken into account as a source of opacity. The computation is based on the Avrett–Krook iterative procedure, which yields a model strictly in radiative equilibrium. Temperature–pressure relations of the two models were found to differ by only a fraction of one percent, but comparison of color distribution of emergent flux reveals variations comparable to differences in the absorption coefficients. The direction of flux variation caused by the change in opacity is interpreted on the basis of the condition of flux constancy. Author

N65-21590 Paris Observatory, Meudon (France).

THEORETICAL RESULTS ON THE EFFECT OF BLANKETING ON $T(\tau)$

R. Cayrel *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 139–140 (See N65-21575 11-30)

The previous work on the effect of blanketing on the value of the ratio T_o/T_{eff} is discussed with reference to differences with earlier work for the solar case caused by the critical assumption that reemission is in LTE in most lines. Since the probability of thermal reemission in lines is from 10^{-3} to 10^{-4} times the probability of radiative reemission in the top layers of the photosphere, the first approximation is not LTE. At this approximation it was found that $T_o = 4800°$ K. A second approximation takes into account the exchanges of energy between the electronic gas and atoms or ions producing the lines through collisions. The only collisions able to compete with the exchange of energy through photoionization and recombination are the collisions with the ground levels of abundant ions having an allowed transition in the visible. It was shown that these processes could lead to $T_o = 4500°$ K. The only significant cooling mechanism seems to be the collisional excitation of strong resonant lines, and the effect is limited to a drop of about 300° K. E.E.B.

N65-21591 Smithsonian Astrophysical Observatory, Cambridge, Mass.

COMPARISON OF ARCHETYPE MODEL ATMOSPHERES, SUMMARY

Owen Gingerrich *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 143–147 (See N65-21575 11-30)

A numerical comparison of a prescribed model atmosphere as computed by different workers led to the following conclusions: (1) No difficulty was experienced in acheiving a flux constancy of a fraction of a percent. (2) The models showed good agreement with regard to emergent monochromatic flux and to temperature–pressure relationship. (3) The surface temperature of a model is strongly influenced by the inclusion of the Lyman continuum frequencies. E.E.B.

N65-21592 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

A STANDARD MODEL ATMOSPHERE FOR A PURE HYDROGEN STAR OF EFFECTIVE TEMPERATURE 10^{4}° K

Myron Lecar (Yale Univ.) *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 148–152 (See N65-21575 11-30)

The temperature distributions for pure hydrogen stars of effective temperature 10^4 deg K were calculated using iterative equations. The sole sources of opacity were the bound–free and free–free hydrogen transitions, with the Gaunt factors set equal to unity. Hydrogen line opacity and electron scattering were neglected. In one model, the opacity in the Lyman continuum was neglected; in a second model it was included; and in a third case, the pressure and the optical depth at the heat of the Lyman continuum were also presented. In all cases, the integrated flux was constant to within one part in 10^3. E.E.B.

N65-21595 Smithsonian Astrophysical Observatory, Cambridge, Mass.

DEPARTURES FROM LTE IMPLIED BY BOUND-FREE AND FREE–FREE TRANSITIONS

Wolfgang Kalkofen *In its* Proc. 1st Harvard–Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 175–184 ref (See N65-21575 11-30)

To investigate the validity of the assumption of local thermodynamic equilibrium in stellar atmospheres, model atmospheres are compared, based on the assumption of local thermodynamic equilibrium (LTE) and the weaker assumption of local kinetic equilibrium (LKE). For simplicity the atmosphere is assumed to be composed of hydrogen atoms, electrons, and protons; the bound–free and free–free transitions are the main concern. Certain effects of the bound–bound transitions are also discussed. Author

N65-21596 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

ESTIMATES OF THE BOUNDARY TEMPERATURE OF A NONGRAY STELLAR ATMOSPHERE

Myron Lecar *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 185–195 refs (See N65-21575 11-30)

Two analytical expressions (in terms of mean absorption coefficients) for the boundary temperature of a nongray stellar

atmosphere, which can be used to predict, qualitatively, the effect on the boundary temperature of line opacity, are presented. As the Rosseland-Mean optical depth approaches unity, the temperature can be calculated from the approximate formula $F\alpha(dB/d\tau_R)$. However, as τ_R approaches zero, departures from grayness cause B to drop below its gray value—the more nongray the opacity, the more pronounced the effect. Author

N65-21597 Smithsonian Astrophysical Observatory, Cambridge, Mass.
BOUNDARY TEMPERATURES FOR MODELS WITH A STEP-FUNCTION ABSORPTION COEFFICIENT
E. H. Avrett and R. Loeser *In its* Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 196-198 (See N65-21575 11-30)

It is pointed out that in some cases the boundary temperature for a nongray atmosphere can be higher than that of a gray atmosphere with the same effective temperature. This fact is illustrated with calculations for a two-stream model. To verify that this result is not simply a feature of the two-stream model, and to show the dependence of the boundary temperature on the parameters characterizing the problem, the results of a large number of calculations based on the usual model are presented. Author

N65-21598 Harvard Coll. Observatory, Cambridge, Mass.
CONVECTIVE STELLAR MODEL ATMOSPHERES
David W. Latham *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 199-212 refs (See N65-21575 11-30)

At present there is no theory that allows unambiguous calculation of the effects of convective energy transport in stellar model atmospheres. At best the mixing-length theory can give an idea of the relative importance of convection over a range of models with different surface gravities, effective temperatures, and chemical compositions. A straightforward and speedy procedure for constructing a convective stellar model atmosphere on a large computer is described, and a slightly different formulation of the equations of the mixing-length theory is summarized. Author

N65-21599 California Univ., Berkeley. Berkeley Astronomical Dept.
CONVECTION IN LATE-TYPE STARS: A FEW RANDOM REMARKS
M. S. Vardya *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 213-215 refs (See N65-21575 11-30)

The treatment of convection in the computation of model atmospheres along the lines of mixing-length theory, the onset of instability, and temperature stratification are discussed. It was found that convergence in the integration of the equation of hydrostatic equilibrium, when convection is present, can be achieved by solving three simultaneous equations using the Newton-Raphson method. In these calculations, the ratio of mixing length to local pressure scale-height is smaller than a given constant value if the depth of convection is smaller than Z/H. In a star of spectral type about MOV and later, the onset of convection may take place at a shallow optical depth of about 0.2 and smaller. Whether the present type of treatment of convection is even valid at such shallow depths is open to question. E.E.B.

N65-21601 Sterrewacht Sonnenborgh, Utrecht (Netherlands).
CONTACT WITH ASTRONOMICAL DATA
Anne B. Underhill *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 225-238 refs (See N65-21575 11-30)

The determination of which spectral features will identify a model with a real star, thereby establishing a connection between the coordinates in the observed HR diagram with the real parameters of effective temperature and acceleration of gravity, is discussed. Also, how well the postulated physical state of the model atmosphere represents the actual state in a stellar atmosphere, including the determination of the relative abundance of the elements, is considered. It was concluded that the models considered gave a fair representation of normal main-sequence stars, but there are reservations about the outermost layers of the models. According to model atmospheres, the line spectra of most stars appear to be abnormal; perhaps, the models are abnormal. E.E.B.

N65-21604 Kiel Univ. (West Gemany).
QUANTITATIVE INTERPRETATION OF STELLAR SPECTRA USING MODEL ATMOSPHERES
B. Baschek *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 253-268 refs (See N65-21575 11-30)

Partition functions and ionization equilibria, equations of state, continuous absorption, zero approximation, pressure distribution, and the Feinanalyze program were discussed. Among the applications considered were the following: (1) calculations for computation of line profiles and equations of state for a mixture of elements; (2) the dissociation equilibrium for the diatomic molecules of hydrogen, carbon, nitrogen, oxygen, and water; (3) the relative number of ions/quantum cell in the ground state of the stage of ionization; (4) and the number of electrons/nucleus and the mean effective molecular weights. E.E.B.

N65-21606 Smithsonian Astrophysical Observatory, Cambridge, Mass.
A COMPARISON BETWEEN MODEL ATMOSPHERES AND OBSERVATIONS OF EARLY-TYPE STARS
Stephen E. Strom *In its* Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 293-311 refs (See N65-21575 11-30)

The goal in calculating model stellar atmospheres is to derive the physical characteristics of the stars. A grid of stellar models has been calculated for the effective temperature range 10000° to 20000° K and for log g = 3 and 4. These models satisfy the condition of constant flux to within 0.1% and incorporate as continuous opacity sources H, H^-, H_2^+, He I, He II, and the effects of electron and Rayleigh scattering. A spectrophotometric study of 11 stars between B5 and A0 provided the means of comparing the fluxes predicted from the theoretical models with observations. The results of this comparison lead to an accurate scale of effective temperatures for these program stars, the majority of which are members of the Pleiades cluster. Author

N65-21608 Harvard Coll. Observatory, Cambridge, Mass.
COMPARISON OF SOME THEORETICAL LINE CONTOURS OF Hγ WITH OBSERVATIONS
F. M. Stienon *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 317-332 refs (See N65-21575 11-30)

The effective temperature and surface gravity of a star can be estimated by comparing the spectrum of a model atmosphere with that of the real star. Such a model atmosphere was used for the calculation of the equivalent width and flux contour of Hγ for effective temperatures of 9000°, 10000°, 12000°, 16000°, and 20000° and surface gravities of 10^3, 10^4, and 10^5. The model was in local thermodynamic equilibrium at all depths. No convection was considered. The condition of flux constancy was satisfied to better than 0.2%. Frequencies in the Lyman continuum were not included. For these models the concentration of helium was 1/6 by number. It was shown that Hγ contours calculated for the detailed nongray atmospheres agreed well with observed line contours except for within 3 Å of the center. The values of log g predicted were for main-sequence stars about 0.3 less than those obtained from eclipsing binaries. E.E.B.

N65-21609 California Univ., Los Angeles.
THEORETICAL MODEL ATMOSPHERE DATA NEEDED FOR INTERPRETATION OF OBSERVATIONAL MATERIAL
L. H. Aller *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 333–335 (See N65-21575 11-30)

The possibility of more precise treatment of the stars which are of special interest is discussed. For a typical star of the earlier spectral class than the sun, the following quantities may be measured: (1) energy distribution in the continuous spectrum both above and below the Balmer limit; (2) the Balmer discontinuity; (3) certain Balmer lines profiles; (4) stronger metallic or helium line profiles; and (5) equivalent widths of a large number of lines including those of low or intermediate intensity. Therefore, a family of model atmospheres characterized by different effective temperatures and surface gravities with a range in metal/hydrogen ratio should be sought. These models should be in strict hydrostatic equilibrium and have constancy of radiative and convective flux, if convection plays a role. Other desirable parameters are also discussed. E.E.B.

N65-21638*# Consultants and Designers, Inc., Arlington, Va.
METHOD FOR MEASURING THE LINEAR DENSITY OF ELECTRONS AND THE DIFFUSION COEFFICIENT WITH THE AID OF INTERMEDIATE-TYPE METEOR RADIOECHOES [METOD IZMERENIYA LINEYNOY PLOTNOSTI ELEKTRONOV I KOEFFITSIENTA DIFFUZII S ISPOL'ZOVANIYEM METEORNYKH RADIOEKHO PROMEZHUTOCHNOGO TIPA]
E. I. Fialko 21 Apr. 1965 13 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 97–103
(Contract NAS5-3760)
(NASA-TT-F-9669; ST-IM-10320) CFSTI: HC $1.00/MF $0.50

A new method is proposed for the measurement of linear density of electrons in an ionized meteor trail by the shape of radioechoes of intermediate-type trails. Described is the measurement method of the diffusion coefficient in the meteor zone region, based upon the accounting of the duration and analysis of the shape of meteor radioechoes from intermediate-type trails. Author

N65-21654*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELDS: REASONS FOR SIMULATION METHODS AVAILABLE
Norman F. Ness Dec. 1964 55 p refs Presented at the Conf. on the Role of Simulation in Space Technol., Virginia Polytechnic Inst., Aug. 1964
(NASA-TM-X-55183; X-612-64-389) CFSTI: HC $3.00/MF $0.50

The spatial environment of the earth with respect to magnetic fields, observation by satellites and space probes, quantitative representation of these fields, and available systems to simulate them are considered. The magnetosphere, the turbulent boundary layer and the interplanetary medium are representative of the characteristic aspects of magnetic fields which must be simulated on the surface of the earth. The magnetic field simulator being fabricated is a 25-foot Braunbek coil system in which three separate sets of coils are employed for three axis cancellation of the earth's magnetic field. The coil systems are capable of being servocontrolled to simulate a stationary weak magnetic field despite the function of time. A secondary set of coils associated with this coil facility were used to monitor the variations of the geomagnetic field. The stability of the coil system is approximately 1/2 to 1 gamma and the cancellation of the earth's magnetic field can be automatically controlled. The utilization of the earth's magnetic field can be automatically controlled. The utilization of the earth's magnetic field in attitude control systems going from strictly interaction to highly sophisticated computer programed active attitude systems is discussed. The necessity for verification of such systems is clear and the utilization of large coil facilities for attitude studies such as that being fabricated is indicated. R.W.H.

N65-21655*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATTITUDE DETERMINATION OF SPIN STABILIZED SPACECRAFT USING A DIGITAL ASPECT SENSOR
Mar. 1965 120 p refs
(NASA-TM-X-55185; X-631-65-13) CFSTI: HC $4.00/MF $0.75

The problem of the force free motion of a rigid body is analytically treated by the application of the three Euler angles to derive rotation with no wobbling motion about the axis of the largest momentum of inertia for a satellite. Equations are formed from measurements to determine the motion of a spinning satellite; in this case it is assumed that a photodetector is mounted behind a slit on the side of the rotating satellite. In another case a horizon sensor is used to measure an angle between the spin axis and the subsatellite zenith. From the values of the auxiliary angles the spacecraft momentum vector position is calculated. Equation plots and tables of error in momentum vector position are included. G.G.

N65-21657*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DISTURBING FUNCTION FOR SOME OF THE HIGHER DEGREE TESSERAL HARMONICS
James P. Murphy and Theodore L. Felsentreger Jan. 1965 23 p
(NASA-TM-X-55187; X-547-65-16) CFSTI: HC $1.00/MF $0.50

The disturbing function due to certain tesseral harmonics (m,n) for (1,5), (2,5), (3,5), (4,5), (5,5), (1,6), (2,6), (3,6), (4,6), (5,6), (6,6), (1,7), (2,7), (3,7), (4,7), (5,7), (6,7), (13,13), (13,15), and (14,15) is given both as a function of Keplerian elements of a satellite and as a function of the rectangular coordinates. Author

N65-21658*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MODIFICATION OF BROUWER'S SOLUTION FOR ARTIFICIAL SATELLITES TO INCLUDE SMALL ECCENTRICITIES AND INCLINATIONS
Paul B. Davenport Jan. 1965 14 p refs
(NASA-TM-X-55189; X-543-65-23) CFSTI: HC $1.00/MF $0.50

The computational formulas used in the Brouwer theory of an artificial satellite are modified by a method similar to that suggested by Lyddane to remove the singularities at circular and equatorial orbits. The Brouwer equations are also modified to reflect the use of the Vinti form for the force function and to show all factors of e'' and sin i'' explicitly. Author

N65-21662*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ERROR ANALYSIS FOR APOLLO EARTH PARKING ORBITS USING RANGE RATE AND ANGLE MEASUREMENTS
A. Marlow Jan. 1965 47 p refs
(NASA-TM-X-55194; X-513-65-42) CFSTI: HC $2.00/MF $0.50

Parametric studies are made of RMS errors in position and velocity for an Apollo Earth Parking Orbit (launch azimuth 90°, height 200 km), using uncertainties in range rate of ± 0.1 m/s and ± 0.03m/s; and in angles of $\pm 2 \times 10^{-3}$ radians, $\pm 6 \times 10^{-4}$ radians, and $\pm 2 \times 10^{-4}$ radians. Range rate and angles are measured every second by a tracking ship located at 26° 40' N and 49° 20' W in order to provide tracking during the time the spacecraft is inserted into the parking orbit. In order to compare the RMS errors in the state vector, two separate sets of error analyses are made which include and exclude the effects of an uncertainty in the tracking ship's location. For this study a total uncertainty in the tracking ship's location of approximately ± 450 meters was assumed. It was found that when range rate and angles are measured, the angles are the dominant influence; i.e., that the position and velocity errors are approximately the same whether $\delta \dot{r} = \pm 0.1$ m/s or ± 0.03 m/s. When station location errors are included, these become the dominant influence and even with a minimum amount of tracking, the RMS errors in position approach the level of the station location error. Author

N65-21667*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PERIODIC WIND COMPONENTS AT METEOR HEIGHTS
R. G. Roper and W. G. Elford Mar. 1965 64 p refs
(NASA-TM-X-55204; X-650-65-86) CFSTI: HC $3.00/MF $0.75

This report demonstrates the power of an analysis developed by Groves (1959), which has been applied to the data collected at Adelaide (35° S) for the 13 months from December, 1960 to December, 1961, inclusive. The results show that the most significant periodic zonal and meridional wind components are the 24 hour and 12 hour, with a smaller 8-hour component occasionally present. In general, the vertical component is random, with an amplitude from one to two orders of magnitude less than that of the horizontal wind. Author

N65-21744# Martin Co., Denver, Colo. Aerospace Div.
THE RENDEZVOUS PROBLEM FOR NEARLY CIRCULAR ORBITS
Maurice L. Anthony and Frank T. Sasaki Dec. 1964 37 p refs
(R-64-11)

An approximate analytical solution is determined by utilizing perturbation techniques. The solution is more general than those previously found since it includes the case where the target orbit possesses small eccentricity and it remains valid for relatively large distances between the vehicles. Hence, the results are useful for many near-earth missions. Numerical examples are provided to assess the accuracy of the solution. The results indicate that in certain instances the present solution, which includes some nonlinear effects, must be used in lieu of previous solutions that are based on a linear theory. An approximate analytical solution is also obtained by which the required velocity components can be determined in order to effect rendezvous at a prescribed time. Author

N65-21770*# Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE
Third Quarterly Progress Report, 1 Jan.–31 Mar. 1965
J. A. Ryan 26 Jun. 1964 48 p
(Contract NAS7-307)
(NASA-CR-62220) CFSTI: HC $2.00/MF $0.50

Reliable data for ultrahigh vacuum frictional-adhesional behavior of silicates with possible significance to the lunar surface are reported. These data indicate a definite load dependence for the adhesion as well as a mineral dependence, and give indications (for given faces in contact) of a crystallographic orientation sensitivity. Adhesion forces in excess of 0.4 gm were detected. Adhesion vs. load data were obtained in vacuum, and at atmospheric pressure, on runs made with orthoclase [001] contacting orthoclase [001], orthoclase [001] contacting hypersthene [110], orthoclase [001] vs. albite [001], and orthoclase [001] vs. pure aluminum. Sample surfaces were studied, and roughness plots were made. The nature of the homogeneous surface charging, mosaic charging, dispersion, and ionic-covalent acting forces is discussed. Modifications made to improve the ultrahigh vacuum system included an electron heating-bombardment system for the high temperature bakeout system, a sample holder to obtain parallelism after pumpdown, a device for rezeroing the balance while at vacuum, and a suspension system to overcome vibration problems. L.S.

N65-21772*# California Univ., La Jolla.
IONIZED GAS IN THE NUCLEI OF ELLIPTICAL, SO, SPIRAL, AND IRREGULAR GALAXIES
E. Margaret Burbidge and G. R. Burbidge Mar. 1965 16 p refs
(Grant NsG-357)
(NASA-CR-62223) CFSTI: HC $1.00/MF $0.50

The intensity ratio of the emission lines Hα and [N II] λ6583 is a sensitive indicator of T_e and the mode of excitation in interstellar gas. The E and SO galaxies in which interstellar gas is known to be present from the occurrence of [O II] λ3727 have been surveyed in the red spectral region, and the results, together with a summary of similar observations in the nuclei of spirals and irregulars, are presented. A total of 85 galaxies has been examined. In E and SO galaxies usually only [N II] λ6583 was seen. Among galaxies showing emission lines in the red, the intensity ratio Hα/[N II] λ6583, which is ~ 3 in spiral arms, is ≤ 1 in 100% of the ellipticals, in 81% of the SO, and in 55% of the nuclei of spirals. This ratio is ≥ 3 in 100% of the nuclei of irregulars. Author

N65-21845# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: AUGUST 1964
1965 78 p *Its* Issue No. 3

Azimuth and elevation readings on various satellites in orbit, made at stations on the island of Malta during August 1964, are tabulated. The tabulations also list the station number and the date; numerous readings were made on each date of observation, and their times are shown. The satellites are the 1960 Gamma 2, Eta 1, Eta 3; the 1961 Sigma 1 and Alpha-Delta 1; the 1962 Beta-Mu 2, Kappa 1, and Beta-Tau 6; the 1963 03A, 14A, 17A, 26A, 27A, 38A, and 53A; and the 1964 04A. J.M.D.

N65-21846# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: SEPTEMBER 1964 (PART C)
1965 46 p *Its* Issue No. 6

This study contains observations of 1963-30A (Midas 7), 1963-30D (Atlas Agena B), 1963-53A (Explorer 19), 1964-04A (Echo 2 Satellite), and unidentified objects. The time, azimuth, elevation, clock readings and reference, accuracy, and estimated visibility of magnitude for all observations are listed. G.G.

N65-21857# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory
3C 343, A DOUBLE RADIO SOURCE WITH VERY WIDE COMPONENT SEPARATION
Alan T. Moffet 1965 6 p refs
(Contract Nonr-220(19))
(AD-457726)

The two sources listed as 3C 343 and 3C 343.1 have very similar intensities and spectra. Since the similarities are so great, it is probable that these sources are physically connected. If so, they have by far the largest ratio of separation to component diameter for any known radio source. There is no satisfactory optical identification, although a moderately bright galaxy lies within the smallest circle which can circumscribe the source. Author

N65-21877*# National Aeronautics and Space Administration, Washington, D. C.
MAGNETOMETER EXPERIMENT
19 Apr. 1965 4 p Presented at the 46th Conv. of the Am. Geophys. Union, Washington, D. C., 19 Apr. 1965
(NASA News Release-65-117-B) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration presents the results of the magnetometer experiment aboard the Mariner IV spaceprobe. The triaxial, low-field helium magnetometer has a sensitivity of 0.5 gamma per axis and a dynamic range of ±360 gamma per axis. Three magnetic field transitions were observed: (1) between 84 000 and 100 000 miles; (2) at approximately 140 000 and 152 000 miles; and (3) between 48 000 and 60 000 miles from earth. The average location of all three transitions points to an outward expansion of the magnetosphere. Preliminary data indicate that no change in the interplanetary magnetic field was detected at about 12 million miles from earth. G.G.

N65-21927# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1966. PART I: SCIENTIFIC AND TECHNICAL PROGRAMS AND PROGRAM MANAGEMENT
Washington, GPO, 1965 660 p Hearing before the Comm. on Aeron. and Space Sci., 89th Congr., 1st Session on S.927, Mar. 8–15 1965 GPO: $2.25

The NASA authorization for fiscal year 1966 is discussed in hearings before the U.S. Senate Committee on Aeronautical and Space Sciences; a transcript of the hearings is presented. Testimony was given by scientists and administrators of NASA, the Atomic Energy Commission, the Weather Bureau, and the Department of Defense. The authorization bill was S.927 and the hearings were held on March 8 through March 15, 1965. J.M.D.

N65-21966* Smithsonian Astrophysical Observatory, Cambridge, Mass.
ANTICIPATED ORBITAL PERTURBATIONS OF SATELLITE 1959 DELTA TWO
Yoshihide Kozai and Charles A. Whitney *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 9–12 ref (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Since the orbit of the satellite is significantly affected by lunar and solar perturbations, numerical integration was carried out to predict its future behavior. These integrations, based on variation of parameters, are preliminary in nature. Variations of the orbital eccentricity due to the moon and the sun are expressed by the equation,

$$\frac{de}{dt} = -\frac{\sqrt{1-e^2}}{na^2e}\frac{\delta R}{\delta \omega}.$$

The perturbed orbit was calculated from the initial orbital data, and the integration was performed taking the semimajor axis as an independent variable. The expected perigee distance of the satellite measured in units of earth radii; expected acceleration in terms of decrease of semimajor axis (in earth radii) per revolution; and the expected semimajor axis measured in earth radii are shown graphically. E.E.B.

N65-21967* Space Technology Labs., Inc., Los Angeles, Calif.
THE ORBIT OF EXPLORER VI: A TEST OF THE DYNAMIC MODEL ATMOSPHERES
Kenneth Moe *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 13–19 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

A new orbit was computed for the Paddlewheel Satellite, Explorer VI (1959 δ-1), using all available tracking observations. This orbit covers the period of time from injection into orbit on 7 August 1959 to final transmitter failure on 6 October 1959, the period during which scientific data were received from the satellite. The orbit was constructed by a new method in which only the initial elements are obtained by conventional least-squares fitting. At subsequent times, all the conservative forces acting on the satellite are assumed to be known, and the drag force is solved by minimizing the residuals of each day's observations. The derived atmospheric densities are compared with the ARDC 1959 Model Atmosphere and with the dynamic models devised by Paetzold, Jacchia, and Priester. None of the early dynamic model atmospheres agree well with the derived densities; however, Paetzold's 1962 Model usually does agree within the standard deviation of the derived densities. Author

N65-21968* Space Technology Labs., Inc., Los Angeles, Calif.
SOLAR-LUNAR PERTURBATIONS OF THE ORBIT OF AN EARTH SATELLITE
Mildred M. Moe *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 20–23 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The perturbations of the orbit of a highly eccentric earth satellite are derived by assuming that the angular velocity of the disturbing body is small enough compared to the angular velocity of the satellite, that the disturbing body may be considered fixed during one revolution of the satellite. This simplification makes possible the integration of the instantaneous rate of change of the orbital elements over one revolution of the satellite to obtain the change in orbital elements per revolution. The magnitude of the error made by holding the disturbing body fixed is then estimated. This leads directly to an evaluation of the effect of the motion of the disturbing body on the semimajor axis, hence the energy, of the satellite orbit. The importance of the solar–lunar perturbations of orbits with high eccentricity was illustrated by computing the perturbations of the perigee distance of 1959 delta. It is shown that the moon's perturbation can lead to only a nonnegligible lowering of the perigee. The sun's influence tends to raise the perigree at first and later the combined influence of the sun and the moon produce an important lowering of the perigree with consequent reduction of lifetime. E.E.B.

N65-21969* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DEVELOPMENT OF THE LUNAR AND SOLAR PERTURBATIONS IN THE MOTION OF AN ARTIFICIAL SATELLITE

P. Musen, A. Bailie, and E. Upton *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 24–58 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Problems relating to the influence of lunar and solar perturbations on the motion of artificial satellites are analyzed by an extension of Cayley's development of the perturbative function in the lunar theory. The results are modified for incorporation into the Hansen-type theory. This theory is applied to the orbits of the Vanguard I and Explorer VI satellites, and the results of detailed computations for these satellites are given, together with a physical description of the perturbations in terms of resonance effects. Author

N65-21970* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE LONG-PERIOD LUNISOLAR EFFECT IN THE MOTION OF THE ARTIFICIAL SATELLITE

Peter Musen *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 59–66 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

This article contains two systems of formulas for the determination of the long-period perturbations caused by the sun and the moon in the motion of an artificial satellite. The first system can be used for the determination of the lunar effect for all satellites. The second method is more convenient for finding the lunar effect for close satellites and the solar effect for all satellites. The knowledge of these effects is essential for the determination of the stability of the orbit of the satellite. The basic equations of both systems are arranged in a form that permits the use of numerical integration. The two theories are more accurate and more adaptable to the use of electronic machines than are the analytical developments obtained previously. Author

N65-21971* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE LONG-PERIOD LUNAR AND SOLAR EFFECTS ON THE MOTION OF AN ARTIFICIAL SATELLITE, 2

Peter Musen *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 67–76 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The disturbing function for the long-period lunisolar effects is developed into a series of polynomials in the components of the vectorial elements in the direction to the disturbing body. This development is convergent for all eccentricities and all inclinations. The equations are established for the variation of elements in a form suitable for the use of numerical integration and for the development of the perturbations into trigonometric series with numerical coefficients. An application of Milankovich's theory of perturbations leads to the equations for perturbed elements in which the small numerical divisors, the sine of the inclination and the eccentricity, are not present. These new equations, like the equations for canonical elements, have a symmetrical form and a wider range of applicability than the equations for elliptic elements. Author

N65-21972* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE LONG-PERIOD EFFECTS IN THE MOTION OF AN ARTIFICIAL SATELLITE CAUSED BY THE ELLIPTICITY OF THE EQUATOR OF THE EARTH

Peter Musen *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 77–83 refs (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

If a satellite has a mean daily motion nearly commensurable with the angular velocity of rotation of the earth, long-period perturbations will influence its motion. The eccentricity of such a commensurable orbit is not necessarily small, as the orbit of Explorer VI shows. A semianalytical method of treating these perturbations was developed, which avoids the development of the disturbing function into powers of the eccentricity, and consequently includes the cases of elongated orbits and orbits with moderate eccentricities. Author

N65-21973* Space Technology Labs., Inc., Los Angeles, Calif.

RADIO PROPAGATION MEASUREMENTS USING THE EXPLORER VI SATELLITE

Carl D. Graves *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 87–90 refs Presented at the Symp. on Exosphere and Upper F Reg.; sponsored by Comm. III of the U.S. Natl. Comm. of the Intern. Sci. Radio Union, Washington, D.C., 4 May 1960 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The results of an experiment to measure the electron density above the ionosphere are presented. The experiment utilized two coherent signals, one vhf and one uhf, transmitted from the Explorer VI satellite. The evidence of the data is that the electron concentration in the vicinity of the satellite, 18 000 km above the earth, was unusually high, of the order of 10^4 electrons/cm^3. However, the results were influenced by unexpectedly high correction factors and possibly by an intense worldwide magnetic storm that occurred during the measurement period. Author

N65-21991* National Aeronatucs and Space Administration. Ames Research Center, Moffett Field, Calif.

INTRODUCTION TO THE MAGNETIC FIELD EXPERIMENTS DESIGNED BY SPACE TECHNOLOGY LABORATORIES, INC.

C. P. Sonett *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 299 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The primary motivations behind the magnetic field experiment carried on Explorer VI are reviewed. The magnetometer experiment was regarded as a survey to explore questions of

gross interest. A result of immediate interest from the experiment was the lack of any noticeable geomagnetic termination. Since apogee was at 8 earth radii, this meant that at least in the evening quadrant, a geomagnetic termination would have to be placed at greater distance. A second effect which persisted both during times of quiet and disturbance was an unmistakable distortion of the geomagnetic field at altitudes near apogee. Although later events suggested the presence of a storm time current, the general view was that the data were a two-dimensional view of the geomagnetic tail. The probability of storm time ring currents flowing is suggested by data taken during disturbed times. Further, a comprehensive analysis of the storm time fluctuations in the magnetic field, together with the data in the radiation detector, has provided a view of the operation of betatron acceleration in the magnetosphere. E.E.B.

N65-21992* Space Technology Labs., Inc., Redondo Beach, Calif.

CURRENT SYSTEMS IN THE VESTIGIAL GEOMAGNETIC FIELD: EXPLORER VI

C. P. Sonett, E. J. Smith, D. L. Judge, and P. J. Coleman, Jr. *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 300–302 refs Presented at the Explorer VI Session of the Cleveland Meeting of the Am. Phys. Soc., 29 Nov. 1957 also published in Bull. Am. Phys. Soc., v. 4, 416, 1959 and Phys. Rev. Letters, Jan. 1960 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The preliminary data taken by the magnetometer indicate the existence of a temporally and spatially variable current system which strongly perturbs the geomagnetic field at geocentric distances of 5 to 7 earth radii. A feature typical of the results obtained was the reasonable agreement between the expected and the measured field at distances less than 5 to 6 earth radii, and the regular occurrence of large-scale deviations at greater distances. However, neither a solitary pass nor repeated orbiting which shows an anomaly in one region of the outer atmosphere constitutes unambiguous proof of annular current closure. The large-scale deviations observed are discussed. In addition to these deviations, the preliminary data indicate a general increase in the magnetic field strength throughout most of the inner zone as well as irregular deviations. E.E.B.

N65-21993* Space Technology Labs., Inc., Redondo Beach, Calif.

SURVEYS OF THE DISTANT GEOMAGNETIC FIELD: PIONEER I AND EXPLORER VI

C. P. Sonett, E. J. Smith, and A. R. Sims *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 303–313 refs Also published in the Proc. of the 1st Intern. Space Sci. Symp., Nice, France, Jan. 1960 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Experimental results obtained by magnetometers carried onboard the lunar probe, Pioneer I, and the satellite, Explorer VI, are presented. Pioneer I data indicate an inverse-cube field decrease between 3.7 to 7 geocentric earth radii. The probe appears to have penetrated the interface region between the geomagnetic and the interplanetary field at an altitude of 13.6 radii. Fluctuations in both the amplitude and direction of the distant geomagnetic field were observed. Explorer VI data also indicate fair agreement between observed and expected values of the magnetic field at altitudes less than 5 earth radii. In the region from approximately 5 to 8 earth radii, the field typically shows regular, large-scale deviations. The characteristics of the extraterrestrial current system responsible are discussed. Author

N65-21994* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SATELLITE OBSERVATIONS OF THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS

E. J. Smith (Space Technol. Labs., Redondo Beach) C. P. Sonett, and J. W. Dungey *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 314–335 refs Also published in J. Geophys. Res., Jul. 1964 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Explorer VI satellite data and surface magnetograms are used to study the gradual and sudden commencement geomagnetic storms of August 16 to 18, 1959. Analysis of these data provides the following conclusions: (1) The geomagnetic field was strongly perturbed but retained its essentially dipolar character out to geocentric distances of 8 earth radii. (2) A long-period variation in the distant field coincided with D_{st} at the surface. The magnitude of the main-phase decrease at $\sim 4R_E$ was ~ 2.5 times larger than at the surface. Variations in the field direction at $\sim 7R_E$ correlate with half-day variations in the horizontal component at the surface and the 3-hour K index. (3) Large irregular field fluctuations with periods exceeding 1 minute were characteristic of the storm period. (4) The large-scale storm field was qualitatively similar to the disturbance field observed previously on nonstorm days. The disturbance field appeared to evolve from quiet to disturbed conditions and then to gradually recover. Author

N65-21995* Space Technology Labs., Inc., Redondo Beach, Calif.

CHARACTERISTICS OF THE EXTRATERRESTRIAL CURRENT SYSTEM: EXPLORER VI AND PIONEER V

E. J. Smith, P. J. Coleman, D. L. Judge, and C. P. Sonett *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 336–340 refs Also published in J. Geophys. Res., Jun. 1960 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Some of the characteristics of the current system discovered by Explorer VI are presented. These currents are located at altitudes beyond 6 earth radii and thus lie outside the Van Allen radiation zones. The presence of the current system gives rise to a major large-scale perturbation of the distant geomagnetic field. Data are presented to show an actual comparison between the absolute experimental values and the theoretical calculations. The perturbation of the distant field is shown by the measurements reported. Also the extraterrestrial field is shown as a function of geocentric altitude. Further, the field amplitude and phase angle in the deviation region, and a comparison of data between a model calculation and Explorer VI and Pioneer V are included. The close agreement with the model and the similarity of the values of the parameters strongly suggest the existence of a ring current around the earth at altitudes of approximately 10 earth radii. E.E.B.

N65-21996* Space Technology Labs., Inc., Redondo Beach, Calif.

A COMPARISON OF EXPLORER VI AND EXPLORER X MAGNETOMETER DATA

Edward J. Smith *In* NASA, Washington Sci. Findings from Explorer VI 1965 p 341–346 refs Also published in J. Geophys. Res., May 1962 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

Explorer VI and Explorer X data are compared graphically. The Explorer VI finding that a large-scale deformation of the geomagnetic field is present even on nonstorm days was confirmed by Explorer X. The disturbance field is such that the dipole field lines are rotated parallel to magnetic meridian planes but retain their essential geomagnetic character. This

result also holds during magnetic storms, at least out to 8 earth radii. Although the Explorer VI data appear qualitatively consistent with either of two explanations, the Explorer X results showed that the disturbance field is never directed northward inside the magnetosphere if the fluctuations occurring at greater altitudes are associated with the outer boundary. In fact, the component of the disturbance field tends to be radial at large distances. This is contrary to what is expected for a ring current. E.E.B.

N65-21998* National Aeronautics and Space Administration, Washington, D. C.
OBSERVATIONS OF LOW-FREQUENCY HYDROMAGNETIC WAVES IN THE DISTANT GEOMAGNETIC FIELD: EXPLORER 6
Darrell L. Judge and Paul J. Coleman, Jr. (Space Technol. Labs., Redondo Beach) *In its* Sci. Findings from Explorer VI 1965 p 358–381 refs Also published in J. Geophys. Res., Dec. 1962 (See N65-21965 11-29) GPO: HC $2.25; CFSTI: MF $2.00

The results from the Explorer VI magnetometer, aspect indicator, and scintillation detector provide direct evidence for the existence of low-frequency hydromagnetic fluctuations in the distant geomagnetic field, as well as some information pertaining to their specific characteristics. The observed phenomena consist of variations in the amplitude and direction of the measured component of the magnetic field accompanied by substantial changes in the intensity of the energetic particles detected by the scintillation counter. The fluctuations exhibited periods between 100 and 500 seconds. Within this range of periods, variations of the order of 10γ ($\Delta B/B \simeq 0.15$) in amplitude and 15° in orientation were observed in the measured component of the field. These field changes were accompanied by fluctuations of about the same relative amplitudes ($\Delta I/I \simeq 0.15$) in the intensity of the detected particles. Of particular interest is an observation of damped, quasi-sinusoidal oscillations detected simultaneously by all three instruments. As a basis for the interpretation of these results, simple models for hydromagnetic disturbances propagating in the transverse, or Alfvén, mode and in the compressional mode are described. The experimental results are compared with those that might be expected if the observed disturbances behaved as suggested by the models, and it is concluded that both modes were observed. The harmonic relationship of their periods is evidence for coupling between the modes. It is shown that these disturbances violate only the third adiabatic invariant required for trapped particles in the region of the geomagnetic field in which the disturbances were observed. Consequences of the existence of these hydromagnetic disturbances are discussed, particularly with regard to their possible effects upon the dynamics of the outer radiation belt. Author

N65-22019# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
A TECHNIQUE FOR SMOOTHING TRAJECTORY DATA
Donald C. Thompson 31 Oct. 1964 48 p
(Contract DA-36-039-AMC-03404(E))
(EDL-M758; AD-459607)

Functional relationships, involving functions of rational forms, have been developed to approximate trajectory tracking measurements over short periods. Techniques have also been developed to fit actual trajectory data to these functional relationships, and programs for machine computation have been written. Tests of fitting capability, using initially perfect data to which noise is added, indicate that an order of magnitude improvement of noisy data may be achieved using these fitting routines. Author

N65-22062# RAND Corp., Santa Monica, Calif.
POSITIVE STABLE LAWS AND THE MASS DISTRIBUTION OF PLANETESIMALS
A. H. Marcus Feb. 1965 21 p refs
(Contract AF 49(638)-700)
(RM-4458-PR; AD-611842)

The mass distribution of planetesimals undergoes evolution because small planetesimals accrete into larger ones and because large planetesimals break into smaller ones by collison. The mass distribution that results from accretion can be described asymptotically by one of the positive stable laws of probability theory since accretion is a strictly additive process. Certain properties of stable laws and random sums of independent, identically distributed random variables are reviewed. It is shown that, under certain assumptions about the initial distribution, the processes of accretion and collision will produce a distribution of mass that follows an inverse power law with the index 2/3. Author

N65-22088# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WHAT SCIENCE LEARNED ABOUT THE UNIVERSE FROM THE FIRST FLIGHT
V. Dobronravov [1962] 12 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow) p 25–34
(FTD-ST-62-4; TT-65-61740; AD-611110) CFSTI: HC $1.00/MF $0.50

The first Soviet manned space flight is discussed in terms of its contribution toward progress in science and technology. Problems involving space flight, weightlessness, and reentry are also described. A brief note concerning the Soviet meteorological satellite program is included. TAB

N65-22162*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGER VII. PART II: EXPERIMENTERS' ANALYSES AND INTERPRETATIONS
Raymond L. Heacock, Gerard P. Kuiper, Eugene M. Shoemaker, Harold C. Urey, and Ewen A. Whitaker 10 Feb. 1965 156 p refs
(Contract NAS7-100)
(NASA-CR-62347; JPL-TR-32-700) CFSTI: HC $5.00/MF $1.00

Analysis of photographs and records transmitted by Ranger VII on July 31, 1964, is presented along with a series of the photographs. Topics of analysis are gross structure of lunar maria, colors and the mesostructure of the maria, structure of Mare Cognitum, structure of crater rays, classes of craters and depressions, structure of the mare floor, frequency of lunar craters, small-scale lineaments on the Ranger VII photographs, the mare ridges, scientific significance of the Ranger VII mission, cratering as the dominant surface process, model of fine structure, erosion, secondary craters, rocks in craters, perfect and imperfect craters, wrinkles on the lunar surface, dimples, valleys, and cracks. The mission is summarized, with respect to the experimenter team, television description, impact area selection, and publication of data. J.M.D.

N65-22163*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
LUNAR LANDING DYNAMICS: THE VARIABILITY OF LUNAR SURFACE MODELS AND SURFACE CONSIDERATIONS FOR THE LUNAR LOGISTICS VEHICLE STUDY
J. Bensko and J. L. Cortez Oct. 1962 31 p
(NASA-TM-X-56328) CFSTI: HC $2.00/MF $0.50

A preliminary model of the lunar surface, which is a first step modification of the basic model for the Lunar Logistics Vehicle study, was prepared. A study of the regional features in the Ocean of Storms including the area from 8° to 12° north of the lunar equator is reported. E.E.B.

N65-22177*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SKY TEMPERATURE BEHIND THE MOON
C.R. Somerlock [1964] 7 p refs
(NASA-TM-X-51716) CFSTI: HC $1.00/MF $0.50 Submitted for Publication

The background sky temperature behind the moon was gained from moon position data for 12 noon each day of December 1965, and their positions were connected into galactic coordinates with the help of coordinate conversion tables. The background sky "temperature" was then read from a galactic radio map plotted at 81 Mc using a 2° × 15° beamwidth. The obtained results are shown in a curve plotting background sky temperature behind the moon for 144 Mc. The obtained values can be extrapolated to other frequencies. The effects of direct moon passage across the center of the Milky Way and its resultant very high noise temperatures in the antenna beam are considered in an example. A table of approximate data of future noise maxima to be avoided for vhf moon bounce attempts employing ordinary equipment is included. G.G.

N65-22187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTERPRETATION OF ε AURIGAE
Su-Shu Huang (Catholic Univ. of Am.) [1964] 16 p refs Submitted for Publication
(NASA-TM-X-51719) CFSTI: HC $1.00/MF $0.50

A model of ε Aurigae was proposed to explain the contradictory behavior of this star found in photometric and spectroscopic observations. This model which consists of a rotating gaseous disk that appears opaque when viewed edge-on resembles the one that was suggested for β Lyrae (Huang 1963). The success of this simple model to explain these two peculiar stars together with the fact that rotating gaseous rings are frequently associated with the primary component of the Algol-type binary systems (Joy 1942, also Sahade 1960) leads to the belief that rotating gaseous rings or disks are the result of natural development of gases that are injected into the binary system by its component stars. This belief is further strengthened by the knowledge that such a rotating ring or disk is dynamically or hydrodynamically feasible (Prendergast 1960, Huang 1964). Author

N65-22199*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MORL CONTROL SYSTEM INTEGRATION
Peter R. Kurzhals [1964] refs Presented at the SAE A-18 Comm. Meeting, New York, 8–10 Jul. 1964
(NASA-TM-X-51807) CFSTI: HC $1.00/MF $0.50

General mission modes and orientations for the Manned Orbital Research Laboratory (MORL) are presented, and an integrated control concept for these modes is discussed. Schematics of the baseline MORL control system and the primary subsystems are used to develop the control component functions during both zero-gravity and artificial-gravity operations. Emphasis is placed on the momentum storage and reaction control subsystems; and characteristic computer results are included to illustrate the control system performance during the orbital mission. These results consider centrifuge operations, aerodynamic and applied torques, control moment gyro desaturation, maneuver capability, and wobble damping. Author

N65-22203*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VENUS, RECENT PHYSICAL DATA FOR
L. D. Kaplan Jun. 1964 6 p refs Submitted for Publication
(NASA-CR-56851) CFSTI: HC $1.00/MF $0.50

Investigations of the planet Venus during the 1962 inferior conjunction, including the measurements during the flight of Mariner II, are reported. The microwave measurements showed unambiguously that limb darkening was present at 19-mm wavelength; therefore the origin of the high thermal emission at centimeter wavelengths is at, or near, the surface of the planet. After eliminating the limb darkening and dividing the resulting brightness temperature by an assumed surface emissivity derived from earth-based radar measurements of reflectivity, a fairly uniform surface temperature of about 700° K was obtained. Among the other results reported were radius of Venus, 6010±30 km; mass, 4.870×10^{27} g, density, 5.36 g/cc; surface gravity, 900 cm/sec^2; retrograde rotation period, 250±40 days; surface pressure, 10±3 bars; cloud top temperature, 200° K. E.E.B.

N65-22205*# National Aeronautics and Space Administration. Washington, D. C.
MICROMETEORITES
Maurice Dubin [1964] 13 p Presented at the Congr. Intern. des Tech. du Vide en Rech. Spatiale, Paris, 29 Jun.–Jul. 1964
(NASA-TM-X-51792) CFSTI: HC $1.00/MF $0.50

Direct satellite measurements of the flux of micrometeorites with acoustical impact detectors, photomultipliers, and rocket collection systems, and the cumulative mass distribution for interplanetary dust particles obtained from meteor and meteor fall frequency observations were studied. The direct measurements of the mass distribution, structure, and other properties of micrometeorites are reviewed. Results indicate a higher flux of particles near the earth than in interplanetary space. The mechanism for the transition to the high near-earth flux is not fully understood. Most interplanetary material accreted by the earth consists of dust particles with masses less than 10^{-8} g and amounts to about 10^4 tons per day. G.G.

N65-22208*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON A MODIFICATION OF HILL'S METHOD OF GENERAL PLANETARY PERTURBATIONS
Peter Musen [1963] 17 p refs Submitted for Publication
(NASA-TM-X-51717) CFSTI: HC $1.00/MF $0.50

A semianalytical theory of general planetary perturbations, somewhat akin to Hill's theory, is developed. In both methods the first-order perturbations coincide, but the theories of perturbations of higher orders are different. Inconveniences of Hill's method—the triple integral in the perturbations of the radius vector and the redundant constant of integration—do not appear. The short and the long period terms containing the squares of the small divisors are localized and combined. The existence of such a direct way of separating these terms from the remaining perturbations constitutes a significant characteristic of a planetary theory. The form of decomposition of perturbations used leads to a system of differential equations easily integrable by Hill's procedure and to a symmetrical scheme for the computation of perturbations of higher orders. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-21163*# National Aeronautics and Space Administration, Washington, D. C.
COMMUNICATIONS SATELLITES—A CONTINUING BIBLIOGRAPHY
Apr. 1965 62 p
(NASA-SP-7004(01)) CFSTI: HC $1.00/MF $0.75

N65-21289# Electro-Optical Systems, Inc., Pasadena, Calif. Technical Translation Dept.
SOVIET SPACE BOOSTERS
Joseph L. Zygielbaum [1964] 31 p Presented at the AIAA Monthly Meeting, Los Angeles, 16 Jan. 1964

In this speech, the development of the Russian space effort from its beginning in 1903, with plans for a rocket motor powered with kerosene and nitric acid as oxidizer, to the Sputnik era, the Luniks, the deep space probes, the carrier rockets for the man-in-space program, the cosmos satellites, and the orbiting space stations, is traced. In 1949 a two-stage rocket was launched for atmospheric studies; in 1958 a three-stage geophysical rocket with a payload of 1520 kg was launched to an altitude of 473 km. Subsequent developments led to the firing of a three-stage booster rocket having a thrust of 20 000 000 horsepower and payload capability of 5 000 kg. It is concluded that much larger boosters are being developed for placing in orbit heavy sizable sections for an orbiting space station. G.G.

N65-21320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE OPERATIONS CONTROL CENTER SATELLITE SITUATION REPORT, VOL. 5, NO. 3
15 Feb. 1965 20 p
(NASA-TM-X-56274; X-533-63-1) CFSTI: HC $1.00/MF $0.50

Data on the satellites in orbit include tabulations on the object, code name, catalog number, launch date, nodal period, inclination, apogee, perigee, and in some cases the transmitting frequency. Also, a list of additional decayed objects is included. E.E.B.

N65-21321*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE OPERATIONS CONTROL CENTER SATELLITE SITUATION REPORT, VOL. 5, NO. 5
15 Mar. 1965 43 p
(NASA-TM-X-56275; X-533-63-1) CFSTI: HC $2.00/MF $0.50

A catalog of satellite and decayed satellite objects in orbit is presented. For objects in orbit, the object code name, catalog number, source, launch, period, inclination, apogee, perigee, and transmitting frequency are listed. For decayed objects, the object, code name, catalog number, source, launch, and decay date are listed. L.S.

N65-21458*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
MARINER MARS 1969 ORBITER STUDY Final Report
4 Oct. 1964 460 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950877)
(NASA-CR-62193; M-29-64-1) CFSTI: HC $7.00/MF $2.25

A study was made of a Mariner Mars 1969 Orbiter, based on the Flox Atlas-Centaur launch system. The objective was to determine the feasibility of performing orbiter and orbiter–capsule missions to Mars and Venus during the 1969–1971 time period with emphasis on a 1969 Mars mission. Mission and performance tradeoffs were made and a conceptual design was developed. A preliminary program plan and preliminary cost estimate was made for a Mars 1969 and a follow-on Mars 1971 mission. The study results indicate that a Mariner Mars orbiter is feasible in 1969 or 1971 and that this orbiter could readily carry an entry capsule. The 1969 orbiter could be modified for a 1970 Venus orbiter mission. The concept lends itself to conservative design approaches and extensive use of Mariner C technology and hardware. A heat-sterilized atmospheric capsule that does not survive landing on the surface of Mars appears quite feasible. A heat sterilized biological capsule, which must survive landing on Mars and perform a biological experiment, does not appear feasible in 1969 when designed to cope with a surface environment of 11 mb atmospheric pressure, 200 ft/sec winds, and rough terrain. Author

N65-21851*# National Aeronautics and Space Administration, Washington, D. C.
NASA SCHEDULES PROJECT FIRE LAUNCH IN MAY
28 Apr. 1965 24 p
(NASA News Release-65-131) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration describes the proposed launching of a 200-pound FIRE spacecraft on a 5000-mile trajectory. The primary purpose is to gather data during the period of highest reentry heating. This blunt-faced vehicle with a conical afterbody will have a flight time of about 32 minutes and a launch window providing total darkness at 400 000 feet in the reentry area. Onboard experiments include direct measurements of radiation from the hot gas cap by means of specially developed radiometers, and measurements of the telemetry transmission to observe the radio blackout caused by the formation of a plasma sheath. The FIRE vehicle will be flown with an Atlas booster. The velocity package will reach an apogee of 500 statute miles after 15 minutes of flight and, at the end of the 21-minute coast period, the reentry package will be accelerated to the correct speed for beginning reentry. This package is not designed for recovery, and the spectrum of light generated during the reentry phase will be measured by telespectrograph in the visible and near infrared wavelength range to define the chemical constituents of the incandescent gas. G.G.

N65-21929*# National Aeronautics and Space Administration, Washington, D. C.
FIRE I: THE REENTRY HEATING SPACECRAFT
[1964] 1 p
(NASA FACTS, Vol. II, No. 11) GPO: $0.15

The National Aeronautics and Space Administration describes the design, mission analysis, and instrumentation of the FIRE I spacecraft used in evaluating the superorbital speed phenomena encountered with the impact of the reentry body on the atmosphere. Its reentry package contained thermocouples, radiometers, signal conditioners, and other instrumentation, and the front consisted of three beryllium layers with

thermocouples, each layer constituting a calorimeter. The calorimeters measured the convective heat transfer from the hot compressed gas cap in front of the reentry package and the additional heat transferred by direct radiation from the incandescent gas cap. The radiometers determined how much of the received heat is due to radiation. An optical ground-based telespectrograph photographed the light spectrum from the hot gas cap for identification of its molecular species. The spacecraft was launched by Atlas booster and all systems operated as expected. Some minor malfunctions occurred but a substantial amount (60%) of useful data was obtained. G.G.

N65-22006# Republic Aviation Corp., Farmingdale, N. Y.
DESIGN PLAN FOR THE BASIC SYSTEM FOR VECTOR MAGNETIC FIELD MEASUREMENTS FROM A JAVELIN ROCKET NOSE CONE Scientific Report No. 2, 1 Jan.–30 Nov. 1964
Percy G. Forsyth 15 Mar. 1965 86 p
(Contract AF 19(628)-2372)
(RAC-2240-1; AFCRL-65-88; AD-460790)

This report describes the results of the feasibility tests of a research program directed toward a basic system for measuring the earth's vector magnetic field from a Javelin rocket nose cone, and indicates the plan to be followed for nose cone payloads to be built. The program is directed to determining the attitude of a Javelin rocket nose cone by means of an electromagnetic attitude sensor using antenna-array signal-strength patterns; making vector component magnetic measurements within the rocket nose cone by means of switched bias coils and a rubidium vapor magnetometer; encoding and telemetering the resulting information in a format compatible with the existing facilities; and developing computational techniques for reducing the data obtained from the above system. Two promising systems for accomplishing the requirement are described and supported by data developed in the theoretical and experimental research. Author

N65-22010# Air Force Systems Command, Eglin AFB, Fla. Ballistic Div.
IMPACT PREDICTION FOR MULTISTAGE SOUNDING ROCKETS Final Report, Feb.–Aug. 1963
K. K. Cobb Dec. 1964 47 p refs
(ATL-TR-64-81; AD-460810)

An accurate method is developed which predicts the burnout angles and impact points of all stages of nonguided finstabilized rockets fired at various launcher settings. The method accounts for the latest wind (within 10 minutes of the launch time), coriolis deflection, and wind drifts after burnout. A small computer is used for the calculations. Author

N65-22129*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE THIRD SOVIET COSMIC ROCKET
14 Nov. 1959 38 p Transl. into ENGLISH from Pravda and Izv. (Moscow), 27 Oct. 1959
(Contract NASw-6)
(NASA-CR-62304; JPL-AI/TRANS-15) CFSTI: HC $2.00/MF $0.50

The launching of the automatic interplanetary station which obtained photographs of the hidden side of the moon is discussed. The station was equipped with radio-technical, photo-television, guidance, program control, and thermal regulation instrumentation, and power systems. Each system is described. Also, the flight trajectory and orbit of the station is considered. The flight trajectory passed at a distance of 7900 km from the center of the moon. The hidden side of the moon is discussed and two photographs are included. E.E.B.

N65-22174*# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
DETERMINATION OF OPTICAL TECHNOLOGY EXPERIMENTS FOR A SATELLITE, PHASE II Engineering Report No. 7924
Herbert F. Wischnia Feb. 1965 197 p refs
(Contract NAS8-11408)
(NASA-CR-62340) CFSTI: HC $5.00/MF $1.25

Earth satellite experiments are recommended which would advance the technology associated with deep space optical communications and diffraction limited optical systems in space. Block diagrams and further system analysis of experiments selected are presented. Also, the key issues of aperture and its effect on channel capacity for a deep space optical communication system were evaluated for a number of crucial parameters. Further, the laser communication performance curves were computed for diameters of 8, 16, 32, and 64 inches for quantum efficiencies of the detector equal to 8% and 100%. The calculations of channel capacity were concluded to provide a communications breakthrough over microwave communication systems. For a 32-inch aperture system, with a 100-milliwatt laser, the channel capacity was 5.2×10^8 bits/sec for 100% quantum efficiency of the sensor, or 0.42×10^8 bits/sec for a quantum efficiency of 8%. E.E.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-21164*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF PACKAGING AND DEPLOYMENT CHARACTERISTICS OF AN INFLATABLE TOROIDAL-SPACE-STATION CONFIGURATION
Clarence O. Keffer Washington, NASA, Apr. 1965 47 p refs
(NASA-TM-X-1079) CFSTI: HC $2.00/MF $0.50

An investigation was conducted to determine the feasibility of a method for folding, packaging, and deployment of an inflatable 24-ft-diam toroidal-space-station model. The model was tested under atmospheric conditions and in a 60-ft-diam vacuum sphere at a vacuum pressure of 1 mm Hg. It was found that the packaging factor of the torus component was 4.1. This packaging factor was determined by dividing the folded volume of the material by the calculated material volume based on 0.084-in. material thickness. The torus was folded and packaged to 1.38% of the fully inflated volume. This procedure reduced the volume from 2311 cu ft to 32 cu ft; it caused no apparent damage to the torus bladder and no permanent creasing, nor did it have any effect on the material permeability in the tests performed. Cords of the filament cage remained tightly bonded to the bladder and did not appear to be damaged. The internal collapsible compartments did not hinder the folding process of the torus and there was no apparent damage to these compartments due to the packaging. Results of the folding and packaging tests indicate that the folding procedures developed can be used for inflatable toroidal-shape configurations. The materials utilized in the construction of the torus were adequate and complied with requirements of a durable inflatable material that could readily be packaged into a tight compact unit with minimum damage to the material. Author

N65-21188# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences
THERMODYNAMIC THEORY OF FINITE LINEAR VISCOELASTICITY
George Lianis Feb. 1965 26 p refs
(Grant NSF-GP-2677)
(A&ES-65-2)

The equation for stress or linear finite viscoelasticity based on the thermodynamic theory of simple materials with fading memory is derived. Comparison with an alternative derivation based on Onsager's principle is also made. Author

N65-21252# Aeronautical Research Inst. of Sweden, Stockholm.
A STATISTICAL METHOD FOR FAIL-SAFE DESIGN WITH RESPECT TO AIRCRAFT FATIGUE
B# K. Ø. Lundberg and Sigge Eggwertz 1964 26 p refs FRENCH and SWEDISH summaries
(FFA-99)

A fail-safe aircraft structure containing a fatigue crack can still carry a certain reduced static loading. As the crack propagates and the strength of the structure decreases, the probability of collapse due to a heavy gust or maneuver load increases rapidly with time. It is possible to limit the probability of collapse to a required low level by regular inspections. A method of calculating the probability of collapse is given for a diffuse wing structure, taking into account the growing probability with service time of crack initiation as well as crack propagation and inspection frequency. Using experimental data available in the literature, realistic numerical evaluations have been made, assuming various stress levels. The influence of approximations introduced is discussed. Author

N65-21253# Aeronautical Research Inst. of Sweden, Stockholm.
A THEORETICAL INVESTIGATION OF CREEP DEFORMATION AND BUCKLING OF A CIRCULAR CYLINDRICAL SHELL UNDER AXIAL COMPRESSION AND INTERNAL PRESSURE
Ake Samuelson (Thesis) 1964 33 p refs FRENCH and SWEDISH summaries
(FFA-100)

A theory is presented for the calculation of deflections and stresses, as functions of the time, in a thin circular cylindrical shell subject to axial compression and internal pressure. Elastic deformations and secondary creep are taken into consideration. The shell is represented by a multimembrane shell, an extension of the double-membrane concept. The resulting system of partial differential equations is solved numerically in the double-membrane case, and the results are presented for several different values of the parameters involved. The possibility of predicting the critical time is discussed in detail, and an approximate method has been achieved. Comparison with available experimental results shows rather good agreement. An attempt is also made to predict the number of circumferential buckles by means of the classical buckling theory, and acceptable agreement is noted in comparison with experiments. Flow scheme and Fortran program for the numerical calculations are given. Author

N65-21257# Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE FREQUENCY OF BENDING VIBRATIONS IN ROTATING TWISTED BLADES
A. Ye. Shneydman, A. V. Trezhetsinskiy, and L. I. Lupilov 15 Apr. 1965 14 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 3, 1964 p 8–12
(JPRS-29615; TT-65-30749) CFSTI: $1.00

Calculation of the frequency of free bending vibrations in rotating twisted turbine blades is discussed, as well as the results of experiments made in connection with them. The calculation scheme is readily adaptable to programing for use with electronic computers. The results of such programing, in connection with the Ural-4 computer, are included. Author

N65-21265# Stanford Research Inst., Menlo Park, Calif. Poulter Research Labs.
ON THE MECHANICS OF INDENTATION AND CRATERING IN SOLID TARGETS OF STRAIN-HARDENING METAL BY IMPACT OF HARD AND SOFT SPHERES
J. N. Goodier 31 Jul. 1964 59 p refs
(TR-002-64)

The report proposes a set of theoretical models for several types of behavior distinguishable in the existing experimental results on dynamic indentation and cratering in solid targets. The behavior of these models is worked out in the main by adaptations of the existing theory of dynamic expansion of a spherical cavity in an elastic–plastic infinite medium. Author

N65-21339# Bureau of Ships, Washington, D. C.
A PRELIMINARY HYDROFOIL DESIGN INCORPORATING A CAVITATION FREE OPERATION REQUIREMENT
William D. Bauman Dec. 1964 34 p refs
(AD-612672)

To verify a cavitation prediction technique, a set of hydrofoils were designed for a proposed hydrofoil ship. Primary consideration was given to avoiding cavitation, and thus to prevent surface erosion and loss of lift problems. A single gas turbine engine was used as the powerplant, and the propellers placed aft. Factors considered in making the design are the mean depth at which the foils will operate, the relative effects of sweep, thickness of the hydrofoil, net flow velocity, drag ratio, stress, aspect ratio for a given taper ratio, velocity, sweep angle, depth, and load. Also taken into account are keel clearance with the wave contours, minimum range of cavitation bucket needed for control in a fully risen sea, planform details, dimensions, sweep angles, and taper ratio. Limited experimental data indicate that an additional correction should be made for the nacelle and strut. The present ship arrangements dictate an airplane configuration with a single power nacelle aft. The nacelle will be the deciding factor on cavitation speed. L.S.

N65-21360# Joint Publications Research Service, Washington, D. C.
A GEOMETRICAL INTERPRETATION OF THE OSCILLATIONS OF AN ELASTICALLY SUSPENDED RIGID BODY
V. G. Aver'yanova and F. M. Dimentberg 13 Apr. 1965 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, Nov.–Dec. 1964 p 10–19
(JPRS-29551; TT-65-30714) CFSTI: $1.00

This paper describes free and forced oscillations of a body assumed absolutely rigid, attached to a base by a certain number of elastic bonds arbitrarily positioned in space. It is assumed that the distribution of the springs excludes any displacement of the body not associated with longitudinal deformation of the springs. The two cases studied are: the plane case, in which all displacements of the body are parallel to a single plane; and the case in which the body is subjected to

the most general three-dimensional displacements. In both cases the geometrical characteristics of motion are studied, and relations between these characteristics and acting external forces are determined. The problem is studied in its linear formulation. Results may serve as a first approximation for the problem in which nonlinear, higher degree displacement components are assumed to exist. Author

N65-21362# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF PULSE DISTORTIONS OF TURBINE BLADES USING THE WAVE METHOD

A. A. Moiseyev, A. A. Petrov, and O. I. Mikhaylov 13 Apr. 1965 13 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 7, Jul. 1964 p 19–21

(JPRS-29566; TT-65-30723) CFSTI: $1.00

Results are presented from experimental and theoretical investigation of distortion of turbine blades by pulse loads. On the basis of the Timoshenko model a design procedure is worked out which permits following, with high accuracy, the distortion of the blades of any length under any conditions of load, and above all for calculation of the pulse loads. Author

N65-21383*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center

DAMPING IN MULTI-BEAM VIBRATION ANALYSES PART I: ANALYTICAL METHODS

C. Chang 24 Aug. 1964 20 p refs

(Contract NAS8-11148)

(NASA-CR-57857; LMSC/HREC-A036478; TM-54/20-2) CFSTI: HC $1.00/MF $0.50

As a preliminary step in the investigation of vibration analyses of multibeam structures with damping, simple analytical methods which are generally applicable for lightly damped structures are investigated. Examples are used to show applicabilities of the outlined methods. Author

N65-21400# Watervliet Arsenal, N. Y. Benet Labs.

BONDING STRESSES ON MICROFIBERS SUBJECT TO TRANSVERSE FLOW OF HEAT

M. A. Sadowsky and M. A. Hussain Mar. 1965 81 p

(WVT-6503; AD-612880) CFSTI: $2.25

A linear temperature field with a resulting uniform-flow of heat through an uninhibited (with respect to deformation) matrix medium produce a spherical bending deformation of the medium free from any stresses whatsoever. However, if a foreign body such as a stiff microfiber is embedded in the matrix the body will resist bending in conformity with the matrix and thus give rise to a local stress field. Depending upon the shape and size of the microfiber, this stress field may lead to the destruction of the bond between the microfiber and the matrix. The exact determination of bonding stresses between matrix and microfiber has been obtained for a prolate spheroidal microfiber using three dimensional Boussinesq potentials and thermoelastic bipotentials. The bonding stresses have been evaluated on a Univac solid state (80) computer for various spheroidal shapes. Author

N65-21417# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).

STABILITY AND AEROELASTICITY OF MECHANICS AND CONTROL OF FLIGHT [FESTIGKEIT UND AEROELASTIZITAT, FLUGMECHANIK UND FLUGREGELUNG]

Dec. 1964 97 p refs In GERMAN and ENGLISH Papers Presented at the Sitzung der Fachausschüsse, WGLR, Bremen, 19 Sep. 1963

(DLR-MITT.-64-06) Available from ZLDI, Munich: 29 DM

CONTENTS:

1. SOME PROBLEMS AND EFFECTS CAUSED BY THE INTERACTION OF STRUCTURAL VIBRATIONS, THE PROPELLANT SLOSHING, AND THE CONTROL SYSTEM OF CARRIER ROCKETS H. F. Bauer (Georgia Inst. of Tech.) p 1–59 (See N65-21418 11-32)

2. INFLUENCE OF THE CONTROLLING LAYER ON THE CONTROL OF HORIZONTAL MOVEMENT OF AN ELASTIC AIRPLANE W. Lincke (Tech. Hochschule Darmstadt) p 59–61

3. PANEL FLUTTER H. Zimmermann (Hamburger Flugzeugbau G.m.b.H.) p 62–90 refs (See N65-21419 11-32)

4. PROPELLANT BEHAVIOR UNDER LOW-G CONDITIONS. STABILITY OF CABLE-COUNTERWEIGHT SPACE STATION F. C. Hung (North Am. Aviation, Inc.) p 91–96 refs (See N65-21420 11-32)

N65-21418 Georgia Inst. of Tech., Atlanta. School of Engineering Mechanics

SOME PROBLEMS AND EFFECTS CAUSED BY THE INTERACTION OF STRUCTURAL VIBRATIONS, THE PROPELLANT SLOSHING, AND THE CONTROL SYSTEM OF CARRIER ROCKETS [EINIGE PROBLEME UND EINFLUSSE, DIE DURCH DAS ZUSAMMENWIRKEN STRUKTURELLER SCHWINGUNGEN, DES TREIBSTOFFSCHWAPPENS UND DES STEUERSYSTEMS BEI TRAGERRAKETEN AUFTRETEN]

H. F. Bauer *In* WGLR Stability and Aeroelasticity of Mech. and Control of Flight Dec. 1964 p 1–59 In GERMAN (See N65-21417 11-32) Available from ZLDI, Munich: 29 DM

The effects of larger rockets on the damping frequencies and on the enlargement of the fuel tank diameter, with its resultant reduction in propellant natural frequencies and subsequently increased difficulty in stabilization of the flying body, are theoretically discussed. Included are (1) the theory of fluid oscillations having a free surface for cylindrical tanks, spherical tanks and other tank geometries, and elastic tanks; (2) descriptions of fluid oscillations as a mechanical mode and the introduction of damping; (3) influence on the stability of the flying body; (4) vertical stimulation; (5) fluid behavior at varying structural stimulations; (6) rotation oscillations of liquids; (7) bending vibrations of large flying bodies; and (8) stability and enlargement functions of large flying bodies.

Trans. by G.G.

N65-21419 Hamburger Flugzeugbau G.m.b.H. (West Germany).

PANEL FLUTTER [BLECHFELDFLATTERN]

H. Zimmermann *In* WGLR Stability and Aeroelasticity of Mech. and Control of Flight Dec. 1964 p 62–90 refs In GERMAN (See N65-21417 11-32) Available from ZLDI, Munich: 29 DM

The characteristics of panel flutter and its differences compared to the classical wing- and tail-buffeting are discussed with emphasis on the influence of supersonic velocities on the vibrations. A short review of some theoretical and experimental investigations pertaining to panel flutter is given, and the U.S. Air Force research program for panel flutter phenomena and its goal are outlined. Transl. by G.G.

N65-21420 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
PROPELLANT BEHAVIOR UNDER LOW-G CONDITIONS. STABILITY OF CABLE-COUNTERWEIGHT SPACE STATION
F. C. Hung *In* WGLR Stability and Aeroelasticity of Mech. and Control of Flight Dec. 1964 p 91–96 refs (See N65-21417 11-32) Available from ZLDI, Munich: 29 DM

Some fundamental stability criteria associated with vehicle flexibility were investigated by use of a simple, idealized model of a cable-counterweight space station with six degrees of rigid body freedom and unlimited number of elastic degrees of freedom. It was found that the stability of a space station is greatly influenced by the flexibility and inertia distribution of the station. The incorporation of elastic degrees of freedom into the otherwise rigid body equations of motion in terms of normal modes is based on small oscillations. The vibration modes for large oscillations have to be determined from nonlinear parameters. G.G.

N65-21499# Pressed Steel Tank Co., Milwaukee, Wis.
TESTING AND EVALUATION OF 10 FIBERGLASS REINFORCED PLASTIC PRESSURE VESSELS
W. O. Kugler 10 Jul. 1964 37 p
(Contract NMDL-1011)
(AD-455105)

Although all cylinders had minor surface scratches and a satisfactory hydroproof test, 2 out of 10 leaked badly at the fittings joint to the filament winding, deterioration in leakage was pronounced in pneumatic fatigue, and deterioration of burst strengths affected both hydro and pneumatic fatigued cylinders. To have these cylinders pass the present test schedules of fatigue and gas leakage specifications, the present structures will have to be strengthened. Author

N65-21518# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR DETERMINATION OF RESIDUAL STRESSES
L. Gribovszki 19 Mar. 1965 14 p refs Transl. into ENGLISH from Kohasz. Lapok (Hungary), v. 95, no. 10, 1962 p 458–462
(FTD-TT-64-726/1+2+3+4; AD-460455)

The sources and methods of measuring residual stresses in products and machine parts are reviewed. An apparatus for rapid accurate deformation-curve plotting is described. The instrument records greatly enlarged deformation curves from prismatic, cylindrical, and ring-shaped specimens during continuous electrolytic etching. The calculation of stresses in individual sample layers, as a function of etching time and thickness removed per unit time, is outlined. E.P.V.

N65-21532# Royal Aircraft Establishment, Farnborough (England).
THE DETERMINATION OF STRESSES AND DEFORMATION NEAR A VERY FINE CRACK [OPREDELENIE NAPRYAZHENII I DEFORMATSII VBLIZI MEL'CHAISHEI TRESHCHINY]
V. V. Panasyuk Ministry of Aviation, Dec. 1964 20 p refs Transl. into ENGLISH from Nauchn. Zap. Inst. Mashinoved. i Avotomat. Akad. Nauk Ukr. SSR, v. 7, 1960 p 114–127
(RAE-LIB-TRANS-1089)

The shape of a very fine crack is defined in the process of its development into a macroscopic crack. The stresses about the tip of a real crack (linear dislocation) are determined, and their finiteness and continuity are established. Author

N65-21625*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
NONSIMILAR SOLUTIONS FOR IMPACT-GENERATED SHOCK PROPAGATION IN SOLIDS Final Report
William J. Rae Mar. 1965 153 p refs
(Contract NAS3-2536)
(NASA-CR-54251; CAL-AI-1821-A-2) CFSTI: HC $5.00/MF $1.00

This report presents analytical solutions for the propagation of shock waves in dense targets struck by hypervelocity projectiles. The solutions considered deal mainly with the high-pressure phases of deformation during which the material strength can be neglected. Several methods of solution are described. Their advantages and limitations are discussed and their accuracy is estimated by comparing their predictions with experiments and with the results of numerical solutions. To illustrate the application of these approximate theories, an example is given of shock propagation in porous targets. Author

N65-21672# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
IMPACT OF AN ELASTIC WEDGE ON A COMPRESSIBLE FLUID Technical Report No. 35
D. Feit, R. Skalak, and H. Bleich Nov. 1964 61 p refs
(Contract Nonr-266(86))
(CU-1-64; ONR-266(86)-CE; AD-612106)

The impact of an elastic or flexible body on the surface of an inviscid compressible fluid is considered. The pressure and velocity fields generated by the impact are computed by a numerical method based on an integral equation formulation of the problem. Each potential is represented by an integral over unknown source distributions. The boundary conditions in terms of these representations lead to integral equations on these source distributions. A numerical scheme for the solution of these equations is presented, and sample computations are carried out for steel and aluminum wedges impacting on water. A simplified model of an elastic wedge impact is also presented in which the elastic body is replaced by a flexible boundary. The results for the flexible boundary impact are compared to those from the more exact formulation. Both cases are also compared to the results for the impact of a rigid wedge. It is found that the rigid wedge diffraction is the primary effect in all the cases of aluminum or steel on water is secondary. Author

N65-21741*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF FACE-SHEET STIFFNESS ON BUCKLING OF CURVED PLATES AND CYLINDRICAL SHELLS OF SANDWICH CONSTRUCTION IN AXIAL COMPRESSION
Robert E. Fulton Washington, NASA, Apr. 1965 28 p refs
(NASA-TN-D-2783) CFSTI: HC $2.00/MF $0.50

A study is made of the effect of the flexural stiffness of the face sheets on the buckling of elastic curved plates and cylindrical shells of sandwich construction subjected to axial compression. The study shows that when the core is very weak in shear, the flexural stiffness of the face sheets can have an important effect on the buckling load. Simple formulas are developed which give good approximations to the buckling load for most practical ranges of the parameters where the effect of face-sheet stiffness is important. Results of these formulas are compared with exact results for an infinitely long curved plate over a large range of sandwich-shell parameters. The results are based on a linear buckling theory for sandwich shells of the Donnell type, which takes into account the asymmetry of the sandwich faces. Author

N65-21752# Rocketdyne, Canoga Park, Calif.
EFFECTS OF CLUSTER START, HEATING, AND VERNIER SOLO DURATION ON ATLAS MA-5 ENGINE PROPELLANT TANK SIZES
M. A. Appel and J. B. Godwin 31 Aug. 1964 78 p refs
(Contract AF 04(695)-528)
(AER-64-3; AD-460998)

The results are presented of an analytical study to determine the possible weight saving through resizing of the Atlas MA-5 engine fuel and LOX tanks. The resized tanks are based on the elimination of vernier engine solo operation or limiting the YLR101-NA-15 MD2 vernier solo duration to 25 to 30 seconds. A detailed explanation of the electromechanical starting sequence is presented to clarify the effect of propulsion system starting requirements on propellant consumption. Author

N65-21775*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
FABRICATION AND EXPERIMENTAL EVALUATION OF COMMON DOMES HAVING WAFFLE-LIKE STIFFENING. PART I: PROGRAM DEVELOPMENT
R. R. Meyer and R. J. Bellifante Nov. 1964 203 p refs
(Contract NAS8-11542)
(NASA-CR-62257; SM-47742) CFSTI: HC $6.00/MF $1.25

Experimental and analytical techniques were used to determine the minimum weight shape and stiffening configuration for doubly curved shells subjected to external buckling pressures. Monocoque shapes considered were spherical, ellipsoidal, and torispherical having clamped boundary conditions. The stiffening configurations considered were meridional, circumferential, combined meridional and circumferential, square-grid, and geodesic stiffened domes. The theory was supported in all phases by experimental tests on plastic models and was concluded by a large-scale aluminum test on the best stiffened configuration. It was concluded: (1) the minimum weight dome shape for a condition of external pressure is a spherical cap with a half-opening angle of $\theta = 60°$; (2) the experimental data for the buckling of monocoque spherical domes shows excellent correlation with the theory of Huang; (3) the geodesic rib-stiffened dome is the most favorable reinforcement arrangement for spherical domes subjected to external pressure, and is approximately 30% to 40% heavier than an optimum honeycomb sandwich dome for an external loading condition. Author

N65-21776*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
FABRICATION AND EXPERIMENTAL EVALUATION OF COMMON DOMES HAVING WAFFLE-LIKE STIFFENING. PART II: DESIGN TABLES FOR GEODESIC GRID STIFFENED SPHERICAL DOMES UNDER EXTERNAL PRESSURE
R. R. Meyer and R. J. Bellifante Nov. 1964 84 p
(Contract NAS8-11542)
(NASA-CR-62269; SM-47742)

Design tables and a description of their use are presented. The minimum weight solution for a geodesic stiffening grid on a spherical shell subjected to external crushing pressure is given. The optimum dimensions are obtained for simultaneous elastic buckling failures of all elements such as ribs, panels, and domes. R.W.H.

N65-21815# Oak Ridge National Lab., Tenn. Reactor Div.
ANALYSIS OF AXISYMMETRICALLY LOADED CYLINDER-TO-SPHERE ATTACHMENTS
F. J. Witt and B. L. Greenstreet Apr. 1965 50 p refs
(Contract W-7405-ENG-26)
(ORNL-3755) CFSTI: $3.00

Tabulated data are presented for determining the maximum stresses and maximum stress intensities for nozzle-to-spherical shell attachment configurations. Data for nozzles having internal protrusions, as well as for those having no internal protrusions, are included. The equations used in the analyses are given, along with a discussion of the conditions at the junction between the nozzle and shell. Comparisons are made between calculated and experimental results, and the influence of Poisson's ratio on the calculated stresses at the junction is illustrated. Author

N65-21821# Douglas Aircraft Co., Inc., Santa Monica, Calif. Solid Mechanics Research Branch
ELASTIC CONSTANTS AND ANALYSIS METHODS FOR FILAMENT WOUND SHELL STRUCTURES
L. B. Greszczuk Jan. 1964 111 p refs
(SM-45849)

Methods of analysis for filament-wound structures are investigated. A brief description is given on the netting analysis and the role of resin in filament-wound structures. The application of the orthotropic analysis to filament-wound structures is outlined. Starting from the elastic constants of the basic materials (glass and resin) elastic constants associated with extension and bending are derived for unidirectional laminates, oriented laminates, bidirectional oriented laminates, and multilayer composites. These elastic constants are utilized in investigating membrane stresses, bending stresses, and interlaminar shear stresses in filament-wound shells. Author

N65-21860# College of Aeronautics, Cranfield (England).
THE STABILITY OF THE SHORT-PERIOD MOTION OF AN AIRFRAME HAVING NON-LINEAR AERODYNAMIC CHARACTERISTICS SUBJECT TO A SINUSOIDAL ELEVATOR OSCILLATION
P. A. T. Christopher Dec. 1964 37 p refs
(COA-AERO-176)

The analysis of the stability and response of second-order nonlinear, nonautonomous systems by Minorsky's stroboscopic method is briefly presented. This theory is used to determine response curves and stability criteria for the short period motion of an airframe having nonlinear normal force and pitching moment characteristics and subject to a sinusoidal elevator oscillation. These results are then compared with those obtained from quasi-linear theory. Some implications of these results in the synthesis of an automatic control system for an air-to-air missile are briefly discussed. Author

N65-21889# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL RESEARCH OF NATURAL OSCILLATIONS OF A SQUARE PLATE IN A SUPERSONIC FLOW
G. N. Mikishev 9 Mar. 1965 11 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1959 p 154-157
(FTD-TT-64-1079/1+2; AD-612415)

Investigation is made of the natural oscillations (flutter) of a flat square plate in a supersonic flow at Mach 1.7, 2.3, and 3 for the case where two edges of the plate are perpendicular to the flow and fastened and two edges parallel to the flow are open. The results of the experiment are compared with the theoretical solution. Author

N65-21898# National Aerospace Lab., Tokyo (Japan).
THREE SHEAR THEORY OF PLASTICITY, ANISOTROPY DUE TO PLASTIC DEFORMATION, INFLUENCE OF INTERMEDIATE PRINCIPAL STRESS ON PLASTIC FLOW, STRAIN RATIO RELATIONSHIP IN PLASTIC DEFORMATION, AND INTERNAL SHEARING RESISTANCES IN THE THREE SHEAR THEORY OF PLASTICITY
Fujio Nakanishi and Yasuo Sato Sep. 1964 47 p refs
(NAL-TR-71T)

A new theory of plasticity was advanced with which experiments on the stress relation between plastic pure shear and plastic tension conform closely. Moreover, the hysteresis loops, the anisotropy due to plastic deformation, and the relation between the yield point of mild steel and the plastic deformation beyond that are accounted for by this theory. Author

N65-22070# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPPORTING POWER OF SKELETON AND CORRUGATED CIRCULAR CYLINDRICAL SHELLS DURING COMPRESSION
S. N. Kan. 15 Feb. 1965 14 p Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 9, no. 5, 1963 p 465–472
(FTD-TT-64-952/1; AD-611422)

A method is proposed for calculating the supporting power of frames and corrugated circular cylindrical shells during compression. This method is based on the assumption that the longitudinal elements of the real shell, having initial bucklings, are in state of longitudinal transverse buckling. Derived are calculation dependences individually for axially symmetrical and nonaxially symmetrical deformations. Resolving square equations graphically shows the effect of individual parameters of the system on the magnitude of the destructive compression stresses. In the order of illustrations are given the examples of calculating the supporting power of corrugated circular cylindrical shells. Measures, leading to an increase in critical stresses of the shell and destructive stresses of individual corrugations or stringers, assist in increasing the supporting power of the system. The described method of calculating the supporting power can be applied to the case of transverse load, which, like buckling, is capable of sharply reducing the supporting power of the shell. The relatively simple method of calculating the supporting power of framed and corrugated shells upon compression offers the possibility of making selection of system parameters from minimum weight conditions, and also to establish maximum buckling amplitude values, which may be committed at manufacture. TAB

N65-22209*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE-TO-NOISE STUDIES OF SOME AIRCRAFT AND SPACECRAFT STRUCTURES
Philip M. Edge, Jr. and Carl E. Rucker [1964] 20 p Ref Presented at the 2d Intern. Conf. on Acoust. Fatigue, Dayton, Ohio, 29 Apr.–1 May 1964
(NASA-TM-X-51739) CFSTI: HC $1.00/MF $0.50

The status of current studies of the dynamic responses of panel shells and complete equipment packages to acoustic inputs is reported. These studies provide information for improving existing fabrication techniques of flight structures exposed to noise loads, and for developing criteria for vibration and acoustic specifications for complex structures of flight vehicles. Representative results are included. E.E.B.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-21191# Rocketdyne, Canoga Park, Calif.
EXPERIMENTAL STUDY OF CONTACT RESISTANCE LINER CONCEPT FOR HIGH-PRESSURE THRUST CHAMBER APPLICATIONS
W. S. Hines Aug. 1964 59 p refs
(RR-64-28)

The possibility of employing refractory metal liners which reduce heat transfer by contact or interface resistance was analytically and experimentally explored. Rocket applications in the fields of high chamber-pressure liquid engines, nuclear engines, and liquid space engines were proposed. Experimental interface heat-transfer coefficients were measured in a novel electrically heated apparatus at heat fluxes to 4.11 Btu/in.^{2} sec and interface ΔT to 1824° F. Author

N65-21213# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMBUSTION TECHNOLOGY OF VOSTOK-TYPE ENGINES, COMPREHENSIVE REPORT Surveys of Soviet-Bloc Scientific and Technical Literature
10 Mar. 1965 146 p refs
(ATD-P-65-5; AD-458908) CFSTI: HC $4.00/MF $1.00

CONTENTS:

1. GENERAL REVIEW p 2–17
2. SOVIET LAUNCH VEHICLES p 18–28
3. VOSTOK ENGINE-DESIGN PRINCIPLES AND ELEMENTS p 29–45
4. PROPELLANTS AND MATERIALS FOR LIQUID ENGINES p 46–58
5. BASIC ELEMENTS OF SOVIET SPACE TECHNOLOGY p 59–63
6. COMBUSTION THEORY AND COMBUSTION-STABILITY PRINCIPLES p 64–75
7. INTENSIFICATION OF COMBUSTION AND COOLING PROCESSES BY ULTRASONIC WAVES, VIBRATION, AND OTHER MEANS p 76–93

APPENDIXES

8. ON THE SIMILARITY BETWEEN COMBUSTION IN A DETONATION WAVE AND IN A ROCKET MOTOR Yu. N. Dension, Ya. K. Troshin, and K. I. Shchelkin p 95–111 refs (See N65-21214 11-33)
9. DETONATION PROCESSES K. I. Schelkin p 113–124 refs (See N65-21215 11-33)
10. INVESTIGATION OF DETONATION WAVE PRESSURE BY THE METHOD OF CRUSHER ROD COMPRESSION S. M. Kogarko p 126–130 refs (See N65-21216 11-33)
11. THE EFFECT OF SOUND ON COMBUSTION PROCESSES P. Greguss p 132–141 refs (See N65-21217 11-33)

N65-21214 Library of Congress, Washington, D. C. Aerospace Technology Div.

ON THE SIMILARITY BETWEEN COMBUSTION IN A DETONATION WAVE AND IN A ROCKET MOTOR

Yu. N. Denisov, Ya. K. Troshin, and K. I. Shchelkin *In its* Combust. Technol. of Vostok-Type Eng., Comprehensive Rept. 10 Mar. 1965 p 95-111 refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ. i Avtom. (Moscow), no. 6, 1959 p 79–89 (See N65-21213 11-33) CFSTI: HC $4.00/MF $1.00

The decisive role of oblique shock waves is established experimentally in the mechanism of high-frequency oscillations during pulsating and spin detonations and in the absence of a planar wave front. It is proposed that the mechanism of pulsations during detonation is similar to the mechanism of oscillations during combustion in a rocket engine. The similarity consists in the following: (1) In both, gradual self-ignition with a compressed heat fuel mixture is assumed. (2) The average state of the chemical reaction products of both processes is described by thermal gasdynamic equations of the same type. (3) Combustion conditions for both processes are determined by the intake rate of the fuel mixture into the combustion zone and by the possibility of the mixture's combustion at this rate. Further, high-frequency oscillations are peculiar to both observed processes. E.E.B.

N65-21215 Library of Congress, Washington, D. C. Aerospace Technology Div.

DETONATION PROCESSES

K. I. Schelkin *In its* Combust. Technol. of Vostok-Type Eng., Comprehensive Rept. 10 Mar. 1965 p 113–124 refs Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 2, 1960 p 12–20 (See N65-21213 11-33) CFSTI: HC $4.00/MF $1.00

The classical theory of detonation, spin detonation, and the instability of plane wave detonation are discussed. Approximate calculations indicate instability of the plane detonation in typical combustible mixtures. A criterion for the loss of stability of a plane detonation is given. The analogy between detonation and combustion in the rocket engine chamber, although implied, is not discussed in detail. Diagrams of a detonation wave and detonation as a shock-wave–reaction-zone complex, and pressure–volume curves for shock wave and for detonation are given. Further, photographs are included for spin detonation and a normal detonation. E.E.B.

N65-21216 Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATION OF DETONATION WAVE PRESSURE BY THE METHOD OF CRUSHER ROD COMPRESSION

S. M. Kogarko *In its* Combust. Technol. of Vostok-Type Eng., Comprehensive Rept. 10 Mar. 1965 p 126–130 refs (See N65-21213 11–33) CFSTI: HC $4.00/MF $1.00

The detonation wave pressure of explosive gas mixtures is discussed. Detonation pressures of several oxygenous fuel mixtures were found to give values in good agreement with those calculated for detonation products at the Jouguet point. Also, pressures in excess of the Jouguet point pressures have been obtained. The general failing of these experiments was the lack of a steady-state mixture detonation and the consequent uncertainty that the measured pressures were not caused by other burning processes instead of the detonation itself. It is known that at the instant of the detonation emergence a higher velocity of wave propagation and a higher pressure are observed. With the aid of a tourmaline-electric transducer with a cathode-ray oscillograph, the recording for a reflected detonation wave of a mixture of $2H_2 + O_2$ of a lower pressure than the Jouguet pressure was observed (40.4 kg/cc vs 46.7 kg/cc). However, for a mixture close to its limiting value (20% hydrogen and 80% oxygen) a reflected pressure which exceeded the Jouguet point (44.2 kg/cc vs 31.0 kg/cc) was observed. A steady state of this case may not have taken place. E.E.B.

N65-21217 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE EFFECT OF SOUND ON COMBUSTION PROCESSES

P. Greguss *In its* Combust. Technol. of Vostok-Type Eng., Comprehensive Rept. 10 Mar. 1965 p 132–141 refs Transl. into ENGLISH from Akust. Zh. (USSR), v. 8, no. 4, Oct.–Dec. 1962 p 420–425 (See N65-21213 11–33) CFSTI: HC $4.00/MF $1.00

The effects of acoustics on combustion processes are discussed, and the acoustic torch nozzle (ATN) which produces sound energy by utilizing the cyclone principle is described. Experiments conducted showed that when the ATN was used, the acoustic energy increased the heat output so much that a smelting temperature was reached in 40 or 50 minutes instead of 1 hour. In addition, fuel consumption was 10% less. Further, metallurgists found that castings obtained by this method had an appreciably better structure and were more suitable for heat treatment. These results probably are derived from the following: (1) The degree of atomization was increased by the influence of the acoustic energy. (2) Stability of the combustion front boundary increased the completeness of combustion. (3) Since the energy was introduced in the flame itself favorable chemico-acoustic phenomena developed. (4) The probability between fuel droplets and oxidizing molecules is increased. (5) A more uniform diffusion coefficient results from more uniform temperature distribution. E.E.B.

N65-21244# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

TRANSITION BOILING HEAT TRANSFER PROGRAM Seventh Quarterly Progress Report, Jul.–Sep. 1964

E. P. Quinn 1 Oct. 1964 25 p refs

(Contract AT(04-3)-189)

(GEAP-4727) CFSTI: $0.50

Transition boiling heat transfer results are presented for a single, 1/2-in.-diam. heated rod in a 3/8-in. hydraulic diameter annular duct. Conditions at 1000 psia were at 0.5, 1.0, and 1.5 million lb/h-ft^2 mass velocities, covering a 20% to 55% steam quality range. Transition boiling in the absence of large flow oscillations does not appear to present a serious design barrier to operation in film boiling. Three heated surfaces were investigated: smooth, 0.002 in., and 0.004 in. high special finned surfaces. The effect of the fins on reducing transition boiling wall temperature fluctuations and increasing film boiling coefficients is illustrated. Test section pressure drop measurements recorded during the tests were very steady, indicating that overall loop disturbances were essentially absent and that this transition boiling data represents the inherent heat transfer process. Author

N65-21255# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

APPLICATION OF AN ADIABATIC CALORIMETER TO THE DETERMINITION OF THE HEATS OF FUSION AND HEATS OF FORMATION OF SEVERAL METALLIC COMPOUNDS

Gerald J. Gartner and Premo Chiotti Feb. 1965 72 p refs

(Contract W-7405-ENG-82)

(IS-1070) CFSTI: $3.00

The general operating principles of this calorimeter are summarized; its application to the measurement of heats of

fusion and transformation of materials, and heats of formation of intermetallic phases is described. The results of the heat of formation experiments are $MgZn_2$ @ 863° K, −4.30 kcal/g-atom; $CaMg_2$ @ 532° K, −3.12 kcal/g-atom; and CeZn @ 823° K, −10.6 kcal/g-atom. The results of the heat of fusion of the materials are $MgZn_2$, 9.687 kcal/mole; $CaMg_2$, 11.744 kcal/mole; CeZn, 7.826 kcal/mole. The average values for the heats of fusion are accurate to ±2%. Author

N65-21282*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENT OF OPTICAL RADIATION FROM THE WAKE OF ABLATING BLUNT BODIES IN FLIGHT AT SPEEDS UP TO 10 KM PER SECOND
Jack D. Stephenson Washington, NASA, Apr. 1965 52 p refs
(NASA-TN-D-2760) CFSTI: HC $2.00/MF $0.50

Optical wavelength radiation from the wakes of small gun-launched models (spherically blunted bodies) was measured at speeds from 5 to 10 km/sec and at stream densities from 0.001 to 0.2 atm. Results indicate that radiation in the wavelength range, 0.2μ to 1.0μ, is caused primarily by the presence of ablation material in the wake. The radiation intensity and spectral quality differ considerably among the various plastic materials tested (a polycarbonate, polyethylene, an epoxy, and polymerized formaldehyde). For conditions at which a majority of the data were obtained, the peak radiant intensity from the wake varied directly with stream density and approximately with the 7.5 power of the flight velocity. The variation of intensity of the wake radiance with downstream distance along the wakes of polycarbonate models, following the region of peak intensity, could be approximated by exponential decay functions. The decay rates varied with the square root of the stream density. When the intensity of the wake radiation is high, the radiative heat load on the body base can be significant. Results of calculations of heating rates on the model base are presented, and relations for scaling heating rates are discussed. Author

N65-21393# General Dynamics/Pomona, Calif.
A SURVEY AND EVALUATION OF ABLATION PHENOMENA
P. A. C. Hanna 31 Jan. 1964 239 p refs
(ERR-PO-138)

The ablation phenomena is discussed, including applications of ablative cooling, description of the ablative process, thermal stress in charring ablatives, testing and describing ablatives, and other topics. Literature reference acquisition and methods of listing are discussed. Analysis of the reporting developments in the field of ablatives is presented. Ablation descriptors are defined and assigned to a list of references. Author

N65-21410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTOR THERMAL PUMP BASED ON THE PRINCIPLE OF COMBINED USE OF THERMOELECTRIC EFFECTS
I. N. Pomazanov and P. L. Tikhomirov 16 Feb. 1965 17 p refs Transl. into ENGLISH from Izv. Leningradskogo Elektrotekhn. Inst. (USSR), no. 51, 1963 p 94–106
(FTD-MT-64-553; AD-612370)

An electronic thermal pump, consisting of a semiconductor thermoelectric refrigerator and a thermogenerator together forming a closed circuit, is described. The principle of action is based on the joint use of the Peltier and Seebeck effects in one instrument, which allows direct heat transfer from less heated bodies to more heated bodies, with an external heat source, but without using electric power as the external source of heat. Several effective models of electronic thermal pumps were prepared and tested for refrigerating ability; the experimental parameters analyzed agreed qualitatively with theoretical calculations. Electronic thermal pumps are considered for use near installations which provide external heat sources, such as big refrigerating installations operating on natural gas, and for utilization of the waste heat of powerful thermal electric power stations. L.S.

N65-21457# General Applied Science Labs., Inc., Westbury, N. Y.
MIXING PROCESSES IN SUPERSONIC COMBUSTION
Antonio Ferri, Gino Moretti, and Simon Slutsky [1964] 61 p refs
(Contracts NAS8-7686; AF 49(638)-991; AF 33(657)-10463)
(NASA-CR-62194) CFSTI: HC $3.00/MF $0.50

Reviewed are analytical approaches to the fluidynamics and chemical problems of supersonic combustion. In the mixing process of two streams moving in a parallel direction, various transport mechanisms take place, including diffusion of species, conduction of heat, and exchange of momentum between two fluids. Two limiting cases are considered analytically for the simple mixing problem; the first states that the two gases do not react, and the second states that the gases react immediately, i.e., the reaction rates are infinitely fast. The process of combustion in a confined flow is quite different from simplified free mixing because of the burner walls. Two sets of modifications were introduced to obtain correct information on the actual behavior of the flame; (1) finite rates of chemical reactions were considered; and (2) constant static pressure in normal direction to the stream was removed, and the effect of external boundary conditions was considered. Using these approaches, considerable progress was made in the mathematical treatment of problems involving coupled axis flows, diffusion, and chemical reaction. The mathematical description of multispecies chemical reactions were expedited and rendered applicable to two-dimensional flow problems. R.W.H.

N65-21485# Geoscience, Ltd., La Jolla, Calif.
HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS Quarterly Technical Report, Mar. 1–May 31, 1964
H. F. Poppendiek, N. D. Greene, C. M. Sabin, R. K. Livett, F. R. Mac Donald et al [1964] 31 p refs
(Contract AT(04-3)-409)
(GLR-25; SAN-409-5)

This report describes Geoscience's high-temperature liquid metal research program for the period March 1 to May 31, 1964. The initial potassium heat transfer research consisting of forced-flow boiling and droplet vaporization is discussed. The characteristics of the forced-flow boiling system are outlined, and preliminary experimental results for potassium droplet vaporization are also discussed. Forced-flow boiling mercury measurements obtained in the radiantly heated boiler system are reported and interpreted. The two sets of measurements are in general agreement with each other and with asymptotic theoretical relations. An analysis is made of low vapor quality forced-flow potassium boiling heat transfer data reported in the literature; these data are compared with predicted values based on the postulate that liquid films exist contiguous to the boiler tube wall. A significant difference between predicted and experimental values is found. The thermodynamic properties of potassium vapor in the superheat region are calculated; specifically, vapor pressure, enthalpy, specific heat, and equilibrium compositions of diatomic and monatomic potassium are presented. Author

N65-21510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF COOLING WINDINGS AND CORES OF ELECTROMAGNETIC PUMPS, DOSAGE METERS AND LIQUID METAL MIXERS

L. A. Verte 18 Jun. 1963 4 p Transl. into ENGLISH from Soviet Patent No. 143983 (Appl. No. 722420/22, 17 Mar. 1961) p 1-2
(FTD-TT-63-497/1; AD-411757)

A new method for cooling windings and cores of electromagnetic pumps, dosage meters, and liquid metal mixers is proposed which uses a liquid metal of low melting point and high boiling point to increase the current conductivity of the tubular winding and exclude the possibility of explosion when in contact with molten metal. Gallium was highly effective as a coolant when the cooled element of the inductor (winding or core) was completely surrounded by liquid metal as in an induction winding of a mixer or in the core of a linear induction pump located in the interior of a cylindrical liquid metal layer. The use of liquid metals as heat carriers for tapping forming thermal energy in atomic reactors was more advantageous than water. When cooling tubular contact windings, liquid metal increased the contact section, thus reducing active losses in the winding. S.C.W.

N65-21550# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE SIMILARITY THEORY TO THE STUDY OF TRANSPORT PROCESSES

G. Fay and B. Zselev 22 Mar. 1965 20 p refs Transl. into ENGLISH from Magyar Tud. Akad. Muszaki Tud. Oszt. (Hungary), v. 33, no. 1, 1964 p 351-363
(FTD-TT-64-1346/1+2+3+4; AD-460497)

The transport theory and the theory of similarity are reviewed, and the application of similarity methods in the field of transport theory with reference to specific examples taken from drying theory is illustrated. The physical system examined considered the parameters of mass of the liquid phase, mass of the vapor phase, and heat. Equations are derived for drying theory in terms of Laplace operators. E.E.B.

N65-21593 Kiel Univ. (West Germany).

SIGNIFICANCE OF UNCERTAINTIES IN THE PHYSICAL THEORY OF RADIATIVE TRANSFER

K. H. Bohn *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 155-168 refs (See N65-21575 11-30)

Local thermodynamic equilibrium (LTE) can be assumed for the H^--free-bound continuum, provided the H_2-molecules are formed by an LTE process. Free-bound continua of neutral H and especially of He I and He II will be formed in LTE only if the radiation field does not differ too strongly from a Planckian distribution. Consequently, in the upper atmospheres of stars of spectral type A and earlier, considerable deviations from LTE in the continuum are possible. The mean temperature stratification $\bar{T}(\tau)$ (the mean is taken over horizontal planes) is completely determined if the fraction of the net flux, which is transported by convection, is known. This fraction is probably small in most stellar atmospheres with the possible exception of late-type dwarfs. However, fairly large temperature fluctuations in a given horizontal layer are possible in any case. Above $\tau \sim 10^{-3}$ the T-stratification becomes sensitive to small changes in the net flux. It is doubtful whether a pure radiative equilibrium stratification occurs in the very high layers of any stellar atmosphere. Author

N65-21600 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMMENTS ON CONVECTION

David Fischel *In* Smithsonian Astrophys. Obs. Proc. 1st Harvard-Smithsonian Conf. on Stellar Atmospheres 21 Dec. 1964 p 217-221 (See N65-21575 11-30)

In the calculation of a series of model atmospheres for the purpose of looking at the integrated effect of the absorption lines, it was felt that convection would play a very important role. Since it begins to alter the temperature-pressure distribution at smaller optical depths as the hydrogen-to-metal ratio increases, the outer layers of the models are altered. As the diffusion approximation, which was considered, does not hold at small optical depths, a correction factor was introduced into all equations that use the diffusion equation. This factor, which is a function of depth, should be a monotonically increasing function approaching 1 at large optical depths. It is considered virtually impossible to work with convection without the diffusion approximation and obtain simple useful equations. However, the error introduced by the diffusion approximation should be accounted for in any iterative scheme for correcting temperature distribution. E.E.B.

N65-21664*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TABLES OF THE BLACKBODY RADIATION FUNCTION. VOLUME I: FOR WAVENUMBERS FROM 250 TO 2745 cm^{-1}, AND TEMPERATURES FROM 150 TO 350°K

L. H. Byrne Jan. 1965 209 p refs
(NASA-TM-X-55197; X-650-65-51) CFSTI: HC $6.00/MF $1.25

Tables of the Planck blackbody radiation function are presented in terms of spectral radiance as a function of wavenumber for each two degrees (Kelvin) of temperature from 150° to 350°. Wave-numbers are taken from 250 cm^{-1} to 2745 cm^{-1} (40μ to approximately 3.6μ) in increments of 5 cm^{-1}. Author

N65-21749# Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena

ULTRASONIC-INDUCED CAVITATION STUDIES Technical Report No. 1

R. Garcia and F. G. Hammitt Oct. 1964 109 p refs
(Grant NSF G-22529)
(Rept.-05031-1-T)

Accelerated cavitation damage devices are considered, and a vibratory device utilizing a piezoelectric crystal is found to be feasible for the studies planned. Test specimens of various materials are attached to the ultrasonic transducer and vibrated at a frequency of about 20 Kc/sec and with maximum amplitude of 2.75 mils. Damage to the materials from the shock waves produced by accelerated cavitation cloud collapse is measured. A list of future test materials and the fluids they will be tested in is given. A high-temperature facility has been built to obtain cavitation damage data in Pb-Bi alloy and in sodium and lithium. L.S.

N65-21784# California Univ., Livermore. Lawrence Radiation Lab.

VOLATILITIES OF THE FISSION PRODUCT AND URANIUM OXIDES

Ray G. Bedford and Donald D. Jackson 20 Jan. 1965 40 p refs
(Contract W-7405-ENG-48)
(UCRL-12314) CFSTI: $2.00

A critically evaluated compilation of data on the free energies of formation of oxides for making vapor pressure calculations at

temperatures up to 2500° K is presented. The equilibrium abundances of the gaseous oxides of the elements between atomic numbers 32 and 62 were calculated with the exception of Br, I, Kr, and Xe. It was assumed that temperature and HO_2 pressure are known at the start, and only equilibria between elements and their own pure, stoichiometric oxide phases were considered. G.G.

N65-21811# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering
DENDRITIC GROWTH IN UNDERCOOLED METALS Progress Report, Aug. 1–Nov. 31, 1964
George A. Colligan, Warren T. Loomis, and Victor A. Surprenant Dec. 1964 26 p refs
(Contract Nonr-3897(01))
(SCP-3; AD-457916)

The experimental measurement of the rate of motion of the thermal front generated in an undercooled melt by the release of the latent heat of fusion in nickel, nickel–copper and nickel–silver alloys is presented. These observations were recorded using a high speed motion picture technique to record the growth of the first solid from the melt. The resultant growth velocities as determined by the thermal front motion are summarized for nickel, nickel–copper, and nickel–silver alloys. In addition to the growth velocities, the final macrostructure is evaluated with respect to crystallographic orientation and correspondence of dendrite growth direction to growth velocity maxima. The variation in final macrostructure and microstructure in the absence and presence of a grain boundary migration inhibiter are considered. Similar growth studies in the low melting point metal, gallium, are reviewed. The high speed photographic technique applied to the measurement of the solid–liquid interface motion in the undercooled gallium permits dendrite growth velocities to be measured. The initial dendrite directions and relation to the final solidified gallium ingot are considered. In this lower melting point metal the initial solid dendrites formed can be seen in the high speed photographs taken during recalescence as well as in the completely solidified ingot. Author

N65-21812# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering
THE SOLIDIFICATION BEHAVIOR OF UNDERCOOLED GALLIUM Progress Report, Aug. 1–Dec. 31, 1964
George A. Colligan and Warren T. Loomis Jan. 1965 49 p refs
(Contract Nonr-3897(01))
(SCP-1; AD-457914)

A technique developed allows supercooling masses of up to 4 grams of gallium. The maximum level of undercooling reached, 76° C, is that reported for droplets of gallium 10 to 100 microns in diameter. These conclusions, among others, are reached: (1) The [111] planes are the densest packed in gallium. (2) Thermally undercoded gallium normally solidifies as a single crystal in melts of 4 grams. (3) Dendrite growth velocity shows marked dependence on the degree of initial undercooling. (4) Gallium dendrites grow along crystallographic axes. (5) Isothermal growth proceeds by a diffuse step mechanism in [111] type planes. (6) Dendritic growth proceeds by the advancement of a completely diffuse [111] face. (7) Growth rate during both isothermal and dendritic growth is limited by formation of the close packed [111] planes. (8) Width of any order dendrite is constant along its length after recalescence is complete. (9) Secondary dendrite spacing decreases as initial undercooling increases. (10) Percent of solid formed during recalescence increases as initial undercooling increases. (11) Secondary dendrites grow at the same velocity as the primary dendrite. Author

N65-21825# National Bureau of Standards, Boulder, Colo. Cryogenic Data Center
THE JOULE-THOMSON PROCESS IN CRYOGENIC REFRIGERATION SYSTEMS
J. W. Dean and D. B. Mann 14 Feb. 1965 44 p refs
(NBS-TN-227) GPO: $0.30

A comprehensive analysis of the Joule–Thomson process as applied to cryogenic refrigeration systems is presented. The descriptions of the process already in the literature are usually for specific applications. In contrast, performance characteristics are presented for helium, para-hydrogen, and nitrogen operations over a large range of process parameters. Author

N65-21880# Little (Arthur D.), Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O, Be-B-O AND Al-Be-O SYSTEMS Quarterly Report, 1 Dec. 1964–28 Feb. 1965
Paul E. Blackburn [1965] 11 p refs
(ARPA Order 315-62)
(QR-11; AD-460597)

The evaporation coefficient of B_2O_3 was obtained by the Motzfeldt method. Measurements were made at several temperatures and were normalized to 1391° K for the computation. Within the precision of the data, the Motzfeldt equation appears to give satisfactory results for B_2O_3 (*l*). The evaporation rate data of liquid and solid Al_2O_3 was also measured and indicated an evaporation coefficient of between 0.5 and 1.0 for both. The effusion rate of BeO was determined using a rhenium Knudson cell. The obtained data are in excellent agreement with JANAF data, and weight balance calculations indicate that less than 1% of the vapor contains rhenium species. A mass spectrometric study of the Al–B–O system has been partially completed. L.S.

N65-21938 United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
HEAT TRANSFER TO MIXTURES OF HIGH PRESSURE STEAM AND WATER IN AN ANNULUS. PART IV: THE EFFECT OF TEST SECTION GEOMETRY
A. W. Bennett, J. G. Collier, and H. A. Kearsey Nov. 1964 69 p refs
(AERE-R-3961, Pt. IV) HMSO: 9s

Data presented for burnout in steam/water flow in internally heated annuli at pressures from 75 to 1250 psia were aimed at elucidating a number of geometrical factors in burnout—the effects of heated length, of heater diameter and annular gap, of supporting the heater, of the disposition of the heated length with respect to the inlet, and of gross disturbances on the heated surface. Supporting the heater gives rise to a considerable increase in burnout heat flux above the unsupported case, which is not necessarily due to the elimination of bowing. As the heater length was increased, the burnout flux fell but the total power supplied to the rod at burnout increased. The effect of disposition of the heated length with respect to the channel inlet varied with quality. Within a narrow range, variations of heater diameter and annular gap did not appear to affect the power which can be fed to the rod before burnout for a given inlet quality. A disruption of the film flow along the heater caused by a recess machined in the surface led to a sharp fall in the burnout heat flux. Author

N65-21939 United Kingdom Atomic Energy Authority, Harwell (England).
SIMULTANEOUS REACTION, DIFFUSION AND BULK FLOW IN TUBULAR SPECIMENS OF GRAPHITE. III: DIFFUSIONAL EFFECTS AT HIGH TEMPERATURES
P. Hawtin and J. A. Gibson 1964 33p refs
(AERE-R-4450)

The variation with temperature and oxygen concentration of the oxidation rate of large tubular specimens of graphite exposed to air on the bore surface was examined. Temperatures in the region 550° to 675° C and oxygen concentrations between 2.5% and 20.8% were studied. The graphite tubes were 6 in. in external diameter, 12 in. long and 1.16 in. in bore. Under these conditions the overall rate of reaction is controlled by the rate of in pore mass transport. The experimental data yielded an apparent energy of activation of 25.0 kcals/g atom and an apparent order of 0.81. Previously derived theories of simultaneous mass transport and chemical reaction were extended to cover this limiting case. Calculations based on the extended theory yielded a true energy of activation for the graphite-oxygen reaction of 48.6 kcals/g atom and an order of reaction of 48.6 kcals/g atom and an order of reaction of 0.62. Author

N65-21944 United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
THERMAL CONDUCTIVITY OF A BOROSILICATE GLASS SUITABLE FOR FISSION PRODUCT WASTES
D. B. Auty and J. R. Grover Dec. 1964 25 p refs
(AERE-R-4685) HMSO: 3s 6d

The thermal conductivity of a borosilicate glass incorporating mock fission product wastes measured by a radial heat flow method was found to vary from 0.00247 cal/cm sec deg C at 200° C to 0.00281 cal/cm sec deg C at 550° C. The temperature drop across the glass–steel interface is small and hardly significant when calculating the axial temperature in cylinders of glass in storage. Author

N65-22014# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
STEADY-STATE CONDITIONS IN AN EXPLOSIVE WHICH IS SUBJECTED EXTERNALLY TO ELEVATED TEMPERATURES
Fred P. Stein Mar. 1965 52 p
(PA-TR-3112; AD-459600)

The steady-state heat-transfer equation containing a term for heat generation by chemical reaction at all points was studied. The heat-generation term was governed by a zero-order rate-of-reaction equation, with which the explosion condition can be obtained rigorously from the mathematics without defining what kind of temperature rise represents an explosion. The temperature variance of the zero-order rate equation was described by the Arrhenius expression, which was approximated by the so-called exponential approximation. The physical parameters were considered not functions of temperature. This approximation is adequate for steady-state problems where temperature differences are not large. Where a steady state was calculated to exist no temperature differences in the explosive in excess of 10° C were observed. If the environment of the explosive is below the minimum temperature of explosion, steady-state temperature gradients can exist in the explosive; if above, then an explosion occurs. The minimum temperature of explosion is not a property of the explosive material itself, for it is quite dependent on the environment, mass, and configuration of the explosive charge. Author

N65-22015# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
TIME TO EXPLOSION FOR AN EXPLOSIVE SUBJECTED EXTERNALLY TO ELEVATED TEMPERATURES
Fred P. Stein Mar. 1965 41 p refs
(PA-TR-3167; AD-459649)

Two mathematical models which describe heat conduction in an explosive accompanied by simultaneous internal generation of heat from thermal decomposition of the explosive were studied. The boundary and initial conditions for one model were such that an infinite slab of explosive of finite thickness, initially at a constant temperature, was suddenly exposed to a constant temperature on its lower surface while its upper surface was perfectly insulated. Zinn and Mader's correlation of the solutions to this problem was used in the study of this model. The other model was that of a semi-infinite solid initially at a constant temperature which suddenly has its surface exposed to an elevated constant temperature. G. B. Cook's correlation of the solutions to this model was studied. Both models used zero-order kinetics to describe predetonation decomposition. The effect of each physical and chemical property considered in the correlations to have a bearing on the computed time to explosion at a given temperature was studied. Results are given on the heat of explosion and frequency factor; density and thermal conductivity; and activation energy and frequency factor. Author

N65-22024# Naval Civil Engineering Lab., Port Hueneme, Calif.
HEAT TRANSFER PROMOTERS IN CONDENSATION AND EVAPORATION Interim Report, Jun.–Sep. 1964
A. H. Repscha 1 Feb. 1965 17 p refs
(N-679; AD-457745)

This critical survey of literature on the promotion of high and reliable heat-transfer rates both in evaporation and condensation was made, and it was concluded that of the many systems under investigation, the use of a grooved surface, the small convolutions of which promote thin film heat transfer, offers the greater promise for continued study. A simple experiment for the establishment of the heat transfer characteristics of such convoluted surfaces, both in evaporation and condensation, is described. Author

N65-22028# Auburn Univ., Ala. Auburn Research Foundation
HEAT TRANSFER THROUGH A HOLLOW CYLINDER SUBJECTED TO TEMPERATURE SHOCK
G. E. Tanger and R. G. Hofer 20 Jan. 1961 80p refs
(Contract DAI-01-009-506-ORD-812)
(Rept.-III; AD-457861)

Finite difference equations are employed to solve the problem of transient heat transfer through a plane wall and through a hollow cylinder. The plane wall is exposed to a temperature shock at both surfaces, while the hollow cylinder is exposed to a temperature shock only at the exterior surface. Any initial temperature distribution may be assumed for the plane wall. The cylinder, however, is assured to be at a constant temperature initially. Various boundary conditions at the exterior and interior surfaces are considered for the hollow cylinder. Digital computer programs are developed for the finite difference equations so that numerical answers may be obtained. Author

N65-22037# Space Technology Labs., Redondo Beach, Calif.
ANALYTIC PERFORMANCE PREDICTION OF ABLATING HEAT SHIELDS
A. H. Silver Oct. 1963 34 p refs
(Contract AF 04(694)-1)
(STL-6121-7554-KU-000; BSD-TDR-64-259; AD-426315)

Preliminary design estimates of ablating heat shield performance have been hampered by lack of a closed form solution of transient heat conduction in a finite slab with a receding

boundary. In this report several such expressions are generated by an inverse technique in which relatively standard solutions of transient conduction with fixed boundaries are examined and the locus of points at a given (ablation) temperature is followed as it proceeds rearward from the heated surface. The receding boundary is postulated to coincide with this constant temperature locus and the heat flux necessary to produce this state of affairs is calculated. The analytic technique is applied to several cases involving triangular heat pulses and the results are compared to a more exact digital computer program solution. Amount of material ablated and thickness required to produce a given backface temperature agree. Author

N65-22071# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF IGNITION OF CONDENSED SYSTEMS BY A GLOWING SURFACE
V. N. Vilyunov and O. B. Sidonsky 11Feb. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 1, 1963 p 131-133
(FTD-TT-64-956/1+2; AD-611549)

Consideration is given to the problem of the ignition of nonvolatile condensed systems, in the volume of which there occur totally exothermic chemical reactions, by a hot wall. TAB

N65-22123*# Auburn Univ., Ala. Dept. of Mechanical Engineering
PRELIMINARY INVESTIGATION OF PRESSURE INFLUENCE ON MULTIPHASE HEAT TRANSFER Report No. II
R. I. Vachon, G. E. Tanger, R. B. Pollard, and D. L. Davis Nov. 1964 60 p refs
(Contract NASB-11234)
(NASA-CR-62345) CFSTI: HC $3.00/MF $0.50

The literature on the effect of transient pressure on nucleate boiling was surveyed. The interrelation of boiling parameters with pressure is discussed. The discussion is based on the assumption that a transient pressure boiling process is an infinite number of steady-state processes (quasi-static). The methods of describing surface texture are discussed. A review of the mechanism of ebullition in boiling heat transfer indicates the necessity of adequate nucleation sites. Corrosion as a means of providing the nucleation sites is discussed. Author

N65-22125*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMAL CONDUCTANCE OF POLYMER CHARS Technical Report, 28 Aug. 1964–28 Feb. 1965
G. R. Cunnington, W. Brashaw, and F. J. Smith 15 Mar. 1965 140 p refs Prepared for JPL CFSTI:
(Contracts NAS7-100, JPL-950868)
(NASA-CR-62350; M-52-65-2) CFSTI: HC $4.00/MF $1.00

In a program to develop ablative materials for space vehicles which will penetrate planetary atmospheres, data and conclusions are presented on thermal conductance of chars formed from nylon–phenolic composites. Six materials, five of nylon fiber in phenolic and the sixth of nylon powder in phenolic, were used to produce chars of varying pore diameter for correlation with measurements of thermal conductance. Thermal conductance was determined as a function of degree of graphitization, density, and pore spectra, from measurements of thermal diffusivity made by the flash technique. In tests at temperatures above that of char formation, thermal conductance increased by as much as a factor of three. Corresponding changes were observed in the extent of graphitization and ordering of the carbon structure. A wide range of conductance values were determined for nylon–phenolic chars. It was concluded that materials of nylon powder rather than fiber are superior because they form a more isotropic char and one which has less tendency to crack. J.M.D.

N65-22153# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics
THERMAL CONDUCTIVITY OF SUPERCONDUCTING LEAD
James Wing Fai Woo Feb. 1965 13 p refs Presented at the Am. Phys. Soc. Meeting, 27 Jan. 1965
(Contract Nonr-401(38))
(TR-1; AD-611439)

Reduced thermal conductivity is plotted against the reduced temperature; for typical weak coupling superconductors like tin and indium, the slope of this plot at the critical temperature is about 1.6. For strong coupling metals such as lead, it is much larger. Strong coupling materials have large electron–phonon matrix elements and plentiful low-energy phonons. These are manifested by having such dimensionless quantities as the ratio of the critical temperature to the Debye temperature and of the energy gap at $T = 0$ to the critical temperature anomalously large. A calculation based on the theory worked out by Ambegaokar and Tewordt shows satisfactory agreement with experiment; they calculated the thermal conductivity starting from Kubo's formula. Author

N65-22156# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC CALCULATIONS OF CERTAIN REACTIONS TAKING PLACE DURING THE SETTLING OUT OF TITANIUM CARBIDE FROM GASEOUS PHASE
V. P. Yelyutin, G. I. Pepekin, and B. S. Lysov 12 Feb. 1965 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 11, 1963 p 5–10
(FTD-TT-64-933/1; AD-611527)

An examination is made of the thermodynamic characteristics of the possible reactions taking place during the reduction of titanium tetrachloride vapors with hydrogen. Evidence indicates the $TiCl_4$ is successively reduced through $TiCl_3$ and $TiCl_2$ to free metallic Ti which immediately reacts with carbon from methane in the mixture to form TiC. TAB

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-21148# Sandia Corp., Albuquerque, N. Mex.
CRATERS FROM FOUR EQUAL CHARGES IN A HORIZONTAL SQUARE ARRAY
Luke J. Vortman Mar. 1965 106 p refs
(SC-RR-65-6) CFSTI: $4.00

Craters were observed resulting from square arrays of 64-pound charges at various spacings and depths. The closest spacings yielded craters very like those from single 256-pound charges, while wider spacings yielded craters more or less square in shape and with a mound or pier at the center.

Generally, the areas so uncovered were greater than for single 256-pound charges, except for very deep charges. Volumes, too, were enhanced by this configuration by as much as a factor of three. If the same factor is maintained for nuclear charges, the cost per unit volume of a crater from such an array will be within 20% of that for a single charge. . . Author

N65-21185# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON ARMY CONSTRUCTION [LITERATUUROVERZICHT, KRIJGSBOUWKUNDE]
4 Jan. 1965 20 p refs In DUTCH *Its* 7th Yearly Issue, No. K-68

Abstracts on civil and mechanical engineering are presented. Among the subjects covered are: (1) instability of stiffened cylindrical shells subjected to hydrostatic pressure; (2) vibrational pile driving; (3) self-contained diesel pile driving hammers; (4) cable-type crossings; (5) sediment scour around structures due to wave action, stream flow, and waves superimposed upon stream flow; (6) pneumatic breakwaters; (7) air compressibility in deep water; (8) designs for naval shore facilities; (9) air-supported tentage; (10) acoustical treatment for engine test stands; (11) design requirements for infrared snow melting systems; (12) diffraction of a plane shock wave by an arbitrary rigid cylindrical obstacle; (13) damage assessment; (14) VTOL aircraft hardening; (15) blast closure devices; (16) Stephenson valves; (17) full-scale submarine test facility; and (18) dismountable pontoons. Author

N65-21218# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 1, NUMBER 3
Mar. 1965 61 p refs Sponsored by DOD
(AD-458290) CFSTI: HC $3.00/MF $0.50

CONTENTS:

1. GAS BREAKDOWN IN A LASER BEAM S. Kassel p 1–8 refs (See N65-21219 11-16)
2. RADIATION DEFECTS IN GERMANIUM FROM NEUTRON BOMBARDMENT S. Hibben p 9–13 refs (See N65-21220 11-26)
3. SOVIET RESEARCH ON NEW HEAT-RESISTANT POLYMERS–POLYBENZIMIDAZOLES B. Nartsissov p 14–22 refs (See N65-21221 11-06)
4. SPACE APPLICATIONS OF RAMJET PROPULSION A. Surak p 23–24 refs (See N65-21222 11-28)
5. RECENT ADVANCES IN HYPERVELOCITY TECHNIQUE L. Boylan p 25–29 refs (See N65-21223 11-11)
6. EPHEMERIDES FOR POSITION DETERMINATIONS ON THE MOON'S SURFACE E. Gelins p 30–34 refs (See N65-21224 11-30)

N65-21288# Indian Inst. of Science, Bangalore.
FIFTY-FOURTH ANNUAL REPORT (1962–1963) OF THE COUNCIL OF THE INDIAN INSTITUTE OF SCIENCE
Bangalore Press, India, 1964 383 p

CONTENTS:

1. INDIAN INSTITUTE OF SCIENCE p 1–89
2. DEPARTMENT OF INORGANIC AND PHYSICAL CHEMISTRY p 91–269 refs
3. DEPARTMENT OF INORGANIC AND PHYSICAL CHEMISTRY p 271–344
4. LIAISON WITH INDUSTRY p 345–355

N65-21386*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GOVERNMENT RESEARCH, THE ENGINEER, AND THE PROFESSIONAL SOCIETY
I. E. Garrick [1965] 10 p Presented at the 31st Ann. Meeting, Southeastern Sect., Am. Soc. for Eng. Educ., Richmond, Va., 12–13 Apr. 1965
(NASA-TM-X-56295) CFSTI: HC $1.00/MF $0.50

Various means of providing continued education for scientists and engineers in space science are discussed generally. The need for continuing scientific education for all space science professional personnel is expressed, and the need for participation by private industry, government agencies, and professional societies is stressed. Current methods for promoting ongoing education include working experience for undergraduates, summer seminars at universities, university extension courses and staff seminars at industrial and space science installations, and conferences and periodicals sponsored by professional societies. J.M.D.

N65-21531# Congress. House. Committee on Government Operations.
SATELLITE COMMUNICATIONS (MILITARY-CIVIL ROLES AND RELATIONSHIPS)
William L. Dawson Washington, GPO, 1965 166 p refs Second rept. by the Comm. on Govt. Operations, 89th Congr., 1st Sess., Union Calendar No. 71, House Rept. No. 178

Military–civil agency roles and relations, commercial carrier developments, government support, military requirements, government telecommunications management, international arrangements, communications satellite experiments, and the history of Project Advent ware considered. The following four recommendations were made in the report: (1) The Department of Defense should proceed without further delay to establish a medium-altitude, random-orbit satellite communications system for operational use. (2) Titan development vehicles should be used to launch communications satellites either in synchronous stationary orbit or in near-synchronous random orbit to supplement the capability of the recommended system. (3) Sufficient satellites should be procured to permit timely system establishment and maintenance. (4) The Department of Defense should give emphasis and attention to tactical military needs. E.E.B.

N65-21622*# National Aeronautics and Space Administration, Washington, D. C.
[ROLE OF SCIENCE AND TECHNOLOGY IN THE NATIONAL SPACE PROGRAM] News Release
James E. Webb [1965] 7 p Address presented at Boy Scout Lunch-O-Ree, New York, 14 Apr. 1965
Available from the Scientific and Technical Information Division

James E. Webb, Administrator, National Aeronautics and Space Administration, discusses the achievement of the three-orbit flight of GT-3 that proved the spacecraft's capabilities to respond to pilot commands while moving at 17 000 mph in space, and outlines the proposed scientific experiments for the future Gemini missions. The program of scientific exploration in space reached a remarkable accomplishment with the Ranger IX flight and its transmittal of moon pictures. Also mentioned are weather and communications satellites which resulted from broadbased and important research in science and technology. G.G.

N65-21737*# National Aeronautics and Space Administration, Washington, D. C.
BIBLIOGRAPHIES ON AEROSPACE SCIENCE—A CONTINUING BIBLIOGRAPHY, JUN. 1964–FEB. 1965

Apr. 1965 57 p
(NASA-SP-7006(01)) CFSTI: HC $1.00/MF $0.50

An annotated bibliography with references to provide a convenient source of information for aerospace scientists and engineers is assembled. Each entry consists of a citation and, when available, abstract. Report literature and journal and book references are included. R.W.H.

N65-21847# National Academy of Sciences–National Research Council, Washington, D. C.
BASIC RESEARCH AND NATIONAL GOALS
Lawrence R. Blinks (Stanford Univ.) et al Mar. 1965 344 p refs A Rept. to the Comm. on Sci. and Astronautics, U. S. House of Representatives

This comprehensive study represents a careful evaluation of the complex and elusive relationship of Government, science, technology, society, individuals, and the interconnections between each. The papers fall into three groups: (1) efforts to lay down general principles and to examine the specific tactical questions arising in connection with the support of science; (2) relation between education and research; and (3) state of biology, medicine, the behavioral sciences, and the earth sciences. Emphasis was placed on the issue of allocation of resources between the sciences and other activities of our society, and the allocation of resources within the different sciences. G.G.

N65-21852*# National Aeronautics and Space Administration, Washington, D. C.
[EUROPEAN INTEREST IN SPACE RESEARCH] News Release
James E. Webb 30 Apr. 1965 23 p Presented at the Meeting of EUROSPACE, Washington, D. C., 30 Apr. 1965 Available from the Scientific and Technical Information Division

James E. Webb, Administrator, National Aeronautics and Space Administration, discusses the participation of the United States aerospace industry in international research, development, and procurement, and its many implications. The vast areas of mutual interest in contracting procedures, costing principles, cost reduction programs, patents and proprietary rights, the preparation of proposals and their selection, the identification and application of new technology, contract performance standards, monitoring and inspection techniques, reliability and many other subjects are mentioned. The function of the National Aeronautics and Space Administration, not only to accumulate knowledge but to expand it and to put it to use, is pointed out, and the requirement for technical advance that the challenge of a lunar landing imposes is evaluated. G.G.

N65-21917# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Abteilung Industrieberatung/Isotopenanwendung
A RADIOMETRIC DISTANCE-STEERING DEVICE FOR CRANES [EINE RADIOMETERISCHE DISTANZSTEUERUNGSVORRICHTUNG FUR KRANANLAGEN]
K. E. Duftschmid, W. Attwenger, and J. Steidl [1964] 20 p ref In GERMAN Submitted for Publication
(SGAE-IB/IA-4/1964)

A safety measure to prevent the collision of cranes working in a common area is described. The device consists of a gamma radiation source in the form of encapsulated Cs^{137} tablets and an oscillograph, both of which are secured to opposite sides of two parallel working cranes. This electronically controlled distance sensor agitates an acoustic alarm signal when the minimal secure distance between the two cranes is reached. A sensitivity of 0.3 sec and a distance measure precision of ±5% makes this device a dependable and effective security system. Transl. by G.G.

N65-21922# Royal Aircraft Establishment, Farnborough (England).
LIST OF R.A.E. TRANSLATIONS ISSUED DURING THE PERIOD 1 JANUARY TO 31 DECEMBER 1964
S. W. Salt, comp. London, Min. of Aviation, Feb. 1965 5 p
(RAE-LIB-BIBL-254)

This list gives, in numerical order, all R.A.E. Library translations published during 1964. Author

N65-22003# Aerospace Corp., Patrick AFB, Fla. Eastern Test Range Office
IMPACT AND KILL PROBABILITY PROCEDURES
J. L. Bagg 25 Feb. 1965 125 p refs
(Contract AF 04(695)-269)
(TDR-269(A4306)-1; SSD-TDR-64-138; AD-461160)

This study gives procedures used to estimate impact and kill probabilities for launches in which the Air Force has an integral part. Methods of estimating each of the factors in the expected kill formula are given; hypothetical examples are employed to elucidate the procedure. The data requirements essential for the completion of such a study are presented. A discussion of closely related subjects including proposals for modifying future mathematical models, effect of errors in estimates, and an interpretation of total kill probability is included. Author

N65-22091# California Univ., Berkeley. Operations Research Center
OPTIMAL LOCATION OF MAINTENANCE DEPOTS
William Whisler 10 Dec. 1964 20 p refs
(ORC-64-20)

An iterative method of solution for optimal location of maintenance depots within a large geographical area, with the sum of all transportation costs and the operating costs of all depots minimized is presented. Considered is a subset $\{1,2,\ldots,m\}$, with $m<n$ to be sources of a single type of goods or service, and at each source a known quantity of goods or services is available. Every point of the set $\{1,2,\ldots,n\}$ is considered as a possible destination, and each unordered pair of points has a transportation cost associated with it. An optimal solution to the determination of optimal numbers of destination and their location minimizes the total cost including the cost associated with locating a destination at a particular node. G.G.

N65-22119# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF THE APPLICATION OF TECHNICAL CYBERNETICS IN POWER ENGINEERING
G. Adonts 30 Apr. 1965 7 p Transl. into ENGLISH from Kommunist (Yerevan), 8 Dec. 1964 p 3
(JPRS-29830; TT-65-30855) CFSTI: $1.00

The successful solution of complicated problems in the application of technical cybernetics to power engineering is closely connected with the creation of a power base and the unification of power systems to insure the necessary development of industry, transport, and other branches of the national economy. The development of new mathematical methods of calculations and investigation of the stability of power systems, distribution of current, long-term development of electrical networks, economic

distribution of generating sources, and energy consuming production constitute the most important problems of contemporary power engineering. Digital and analog computers work in direct linkage with different devices for automatic adjustment, and use input and output of corresponding information in a number of institutes of the U.S.S.R. Successful solutions were found for the fuel-power balance for separate regions of the country, for economic processes of complicated power systems and their stability, for process stabilization of large units of an electrical station, and for other research problems. G.G.

N65-22202*# George Washington Univ., Washington, D. C.
PATENTS FROM GOVERNMENT-FINANCED RESEARCH AND DEVELOPMENT
Donald Stevenson Watson and Mary A. Holman [1964] 44 p refs Submitted for Publication
(Grant NsG-425)
(NASA-CR-56740) CFSTI: HC $2.00/MF $0.50

This is a report on the numbers of patents arising in the postwar period from Government-financed research and development (RTD). The many previous studies and investigations of federal patent policies never yielded more than incomplete and often inconsistent data. The total number of patents, owned by or licensed to the Federal Government, has grown rapidly. The total, however, is quite small when compared with the total of all patents issued or assigned in the postwar period to residents of the United States and to U.S. corporations. The numbers of patents from Government-financed R & D have grown and fluctuated in step with applied research, but with a lag whose average length is estimated to be at least 5 1/2 years. Author

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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